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ABSTRACT

This volume consists of nine papers dealing with transportation education and training in the 1980's. Contents of the volume are the following articles: "Development of a Unique Highway Safety Curriculum," by Larry E. Jones; "Railroad Engineering Education at the Undergraduate Level," by Richard G. McGinnis; "Cooperative Training Programs for Undergraduate Students," by C. S. Papacostas; "Overall Assessment of a Statewide Certificate Program in Transportation," by Louis M. Rea and James H. Banks; "Role of Outreach Activities in Transportation Education," by Robert P. Schmitt, Edward A. Beimborn, David Cyra, and Alan J. Horowitz; "Transportation Engineering and the University: Past, Present, and Future Challenges," by Roger P. Roess and Louis J. Pignataro; "Training of Transport Specialists," by K. W. Studnicki-Gizbert; "Who Reads the Transportation Planning Literature?" by Gerald S. Cohen, Frank McEvoy, and David T. Hartgen; and "State and Regional Roles in Public Surface Transportation: Education, Training, and Research Contribution of Universities," by Michael D. Meyer and Robert E. Paaswell. (MN)

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TRANSPORTATION RESEARCH RECORD 793

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Transportation Education and Training: Meeting the Needs of the 1980s

TRANSPORTATION RESEARCH BOARD

COMMISSION ON SOCIOTECHNICAL SYSTEMS
NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY OF SCIENCES
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Development of a Unique Highway-Safety Curriculum

LARRY E. JONES

The Federal Highway Administration (FHWA) determined in early 1976 that no comprehensive and in-depth study program existed that would adequately address the highway-safety training needs of federal, state, and local transportation agencies. This paper discusses a contract undertaken between FHWA and Northwestern University to develop a program that would meet the immediate needs of transportation agencies for safety training and, beyond that, to develop training materials that could be used by educational institutions to increase the emphasis given to safety in their transportation curricula. Northwestern University developed an 11-week program aimed at providing concentrated graduate-level study in highway safety for engineers and safety managers who work in the area of highway safety and traffic engineering. The objectives of the program were to sensitize participants to their responsibilities for improving highway safety and to help them acquire knowledge of the latest technology available to effectively carry out their safety programs. This paper discusses the content of this unique program, the participants who have attended, the results of follow-up evaluations, the use being made of the materials by other schools, the plans for updating course materials, and the effectiveness of the program in meeting its intended objectives and at the same time helping to improve the working relationship between the educational community and FHWA.

In early 1976, the Federal Highway Administration (FHWA) determined that no comprehensive and in-depth study program existed that would adequately address the highway-safety training needs of federal, state, and local transportation agencies. Between 1972 and 1976, FHWA had awarded approximately 140 fellowships, each for one year of safety-related study. Follow-up evaluation indicated that these grants were successful in preparing recipients for increased responsibilities in the field of highway safety. However, the study programs that were being offered by most schools did not concentrate on highway safety and moreover many agencies were unwilling to let employees leave their jobs for a full year of study.

It seemed highly probable that the effectiveness of safety programs could be greatly enhanced if university study programs were oriented more directly toward highway safety and traffic engineering. However, efforts to persuade the schools to strengthen their safety programs met with only limited success. The schools could not devote the necessary faculty to developing and presenting safety courses. During this period, there was much national concern about making the highways safer.

On the basis of these circumstances, FHWA determined that the national safety program would be greatly strengthened by a concentrated comprehensive safety and traffic study program developed by a contract expressly to meet the training and educational needs of transportation agencies. Consequently, FHWA contracted with Northwestern University to develop such a program. Northwestern had an outstanding reputation in the field of highway safety and traffic engineering built on graduate programs offered by the Technological Institute as well as on popular one-week to three-week courses given regularly by the Traffic Institute. These two institutes, by working cooperatively, had demonstrated a unique ability to merge their separate resources to produce challenging high-level programs.

Three long-range objectives served as the basis for the initial contract:

1. To develop a comprehensive highway-safety curriculum for a course of approximately 12 weeks' duration,
2. To conduct two training sessions that would be attended by about 20 employees of highway and transportation agencies who were charged with duties directly related to highway safety, and
3. To provide complete instructional and student materials to other educational institutions to assist them in increasing the emphasis given to safety in their transportation curricula.

The manner in which these objectives were accomplished is the framework for this paper.

CURRICULUM DEVELOPMENT

Various program lengths were discussed when the amount of subject material to be presented and the amount of time employees could be spared from their jobs were compared. It was agreed that a concentrated course 11-12 weeks long would be the most suitable option. With this in mind, FHWA asked Northwestern to develop a comprehensive highway-safety curriculum oriented principally toward highway safety and traffic operations and toward the highway-safety standards that pertained to and impinged on the highway and its environment. The curriculum was to support the national safety program administered by FHWA and was to be oriented particularly to the needs of state and local highway-safety programs. The curriculum was to emphasize at least these functional and topical areas as they apply to safety:

1. Planning (safety considerations of rural and urban planning);
2. Design [by using a publication of the American Association of State Highway and Transportation Officials (1)];
3. Operations (including traffic through work zones);
4. Traffic studies and statistics (theory and application to planning, design, and operation);
5. Data analysis;
6. Interdisciplinary study;
7. Administration, management, and legal considerations;
8. Human factors;
9. Research-and-development accomplishments;
10. Interaction between private and public transportation;
11. Hazard recognition; and
12. Areas emphasized by FHWA.

Northwestern was to develop a curriculum that was practical to carry out and at the same time heavily focused on highway safety through all phases of highway development and operations. Northwestern was responsible for identifying the most recent research-and-development studies and those concepts that were still evolving and for incorporating the most relevant materials into the program. Instructional guides and student notebooks were to be prepared that used available references, texts, and other materials. These were to include, as a minimum requirement, lesson plans that specified training objectives, lecture notes, references, visual aids, problems, and means of testing or evaluating student achievement.

The curriculum was to be aimed at an audience of engineers, planners, and safety managers that had had sufficient mathematics, science, and engineering

Table 1. Highway Safety and Traffic Study Program course participants.

Employer	Course Date: Jan.-March 1978	June-Aug. 1978	June-Aug. 1979	June-Aug. 1980	Total
Government agency					
Federal	7	4	7	-	18
State	9	7	7	8	31
City	1	6	3	2	12
County	-	3	-	-	3
University	-	-	2	-	2
Total	17	20	19	10	66

background to qualify them for admission to graduate study in civil, traffic, or transportation engineering. Consideration was also to be given so that certain professionals, who might not have qualified for graduate study, could enter the program. It was desirable (although not essential) that the program yield graduate credit for those participants who met Northwestern's graduate school admission requirements.

The comprehensive curriculum, entitled Highway Safety and Traffic Study Program, prepared by Northwestern represents the most extensive compilation of highway-safety training material known to exist. The program is divided into 34 modules (module 31 no longer exists as a separate unit):

1. Program Objectives and Framework;
2. Accident Phenomena--Epidemiological;
3. Systems Framework for Highway Safety;
4. Statistics;
5. Evaluation Methodology;
6. Accident Reconstruction;
7. Historical Overview of Accident Prevention and Severity Reduction;
8. Human, Vehicular, and Roadway Factors;
9. Traffic Characteristics and Studies;
10. Traffic Stream Flow and Capacity;
11. Intersection Performance and Capacity;
12. Uniform Traffic Control Devices;
13. Traffic Signals;
14. Traffic Operational Controls and Treatments for Safety;
15. Accident-Reducing Potential of Traffic Controls;
16. Freeway Surveillance and Incident Management for Safety;
17. Maintenance Management for Safety;
18. Traffic Management in Construction and Maintenance Zones;
19. Traffic Management of Land Development;
20. Basics of Geometric Design;
21. Geometric Design of Highway Facilities;
22. Design Techniques;
23. Special Techniques and Tools for Safe Highway Design;
24. Urban Transportation Planning;
25. Statewide Transportation Planning;
26. Police Traffic Management;
27. Laws and Legal Considerations;
28. Motor Vehicle Administration;
29. Education and Other Programs;
30. Accident Information Systems;
32. Identification and Treatment of High-Hazard Locations;
33. Evaluation Systems in Highway Safety;
34. Management of Highway-Safety Programs; and
35. Highway-Safety Issues and Practices.

Nearly all the modules are designed to include a combination of lecture and laboratory sessions, which may be supplemented by problem sessions, guest lectures, and field trips. Because of the concentrated nature of the course, it was anticipated that a great deal of independent reading and study would be required outside of class.

An important aspect of the program as designed by Northwestern was the opportunity for participants to study independently and to prepare a paper on a current highway-safety issue relevant to their interests and to those of the other course participants. Although this paper was not intended to be a thesis, it was anticipated that the participants would devote about 60 h to researching the topic and preparing the paper.

TRAINING SESSIONS

A total of four presentations of the 11-week Highway Safety and Traffic Study Program was conducted by Northwestern--two under the original contract and two more through contract modifications. Table 1 shows the number of participants who attended each session by type of employer.

All participants admitted to the program were supported by educational grants from FHWA. Participants who received grants were selected on the basis of their potential to contribute to their employer's highway-safety programs, their relevant experience, and their academic and professional achievements.

All applicants were also screened by Northwestern to determine whether their academic background would qualify them for admission to the program and whether they would be eligible to receive graduate credit. Approximately 38 percent of those who attended did receive graduate credit, which was equivalent to four courses or one-third of the credits required for a master's degree. Grant amounts for all sessions covered tuition, fees, and study materials and included a living stipend. For the first session the maximum stipend was $1500; thereafter the maximum was raised to $3500 for those participants who were not receiving salary support from their employers.

Before being admitted to the program, all participants were required to sign an agreement to work in public service for a specified length of time on completion of their training. Participants were also required to agree to respond to brief questionnaires designed to assist in program evaluation during the study period and for three years after.

So far, the first annual follow-up evaluations have been received from participants who attended both the first and second sessions of the course. A review of these evaluations indicates overwhelming support of the program by the students and placement of very high value on the benefits of knowledge gained during the course. Approximately 70 percent of the participants are now in positions that include heavy responsibility for programs related to highway safety. An additional 20 percent, although not directly responsible for highway-safety programs, are in positions in which safety factors must be considered on a routine basis.

One important benefit of the course is the increased sensitivity participants now feel toward their highway-safety responsibilities. Nearly 85 percent of the participants indicated significant shifts in their attitudes and many have a much stronger desire to improve the safety of highways beyond the minimum standards.

DISSEMINATION OF CURRICULUM MATERIALS

FHWA administers the College Curriculum Program through which educational materials developed for FHWA-sponsored training courses are made available for inclusion in the curricula of technical institutes, colleges, and universities. On request, complete sets of student and instructional materials are provided to schools at no charge. The intent is that schools that offer transportation-related curricula will adapt much of this latest state-of-the-art material to their own programs and thereby enhance their course offerings.

The third and longest-range objective of the Highway Safety and Traffic Study Program was to compile all student notes and instructor materials (including lesson plans, instructor and student objectives, laboratory problems, and all visual aids) used by Northwestern to conduct the course. Copies of these materials were then to be made available through the College Curriculum Program and thus the materials would be obtained by a large number of college faculty at a nominal cost. The success of this activity has greatly exceeded the initial expectations.

In January 1979, a special briefing was held in conjunction with the Annual Meeting of the Transportation Research Board to acquaint college faculty with the program and to let them know that materials from the course would be made available to them at a later date. In January 1980, a special bulletin was prepared to advise faculty that sets of materials that contained approximately 3500 pages of text and 920 35-mm slides were ready for distribution. Since that time, 61 complete sets of the materials and 91 partial sets have been sent out. The distribution of these materials is as follows:

Recipient	Number of Sets Complete	Partial
U.S. college	51	9
Foreign college	3	2
State highway agency	1	1
Military installation	--	1
City	2	--
County	1	6
Regional planning commission	1	--
Consulting engineer	1	5
Course participant	--	66
Private individual	--	1
Total	60	91

There was some concern that it might take several months for professors who were working independently to review all the material developed by Northwestern and to incorporate the relevant subject matter into the curricula of their own schools. In order to shorten this time as much as possible, a 3-week College Faculty Overview Session was conducted with the regular 11-week session during the summer of 1980. Faculty who represented 19 schools were selected to attend the special session and each received a $1000 grant from FHWA to cover their living expenses while they were at Northwestern.

In addition to becoming thoroughly familiar with the course materials, the faculty members who attended the session were asked to participate on various panels to discuss ways in which the safety materials could be used in (a) extension and/or in-service training programs, (b) existing transportation and highway engineering courses, and (c) creation of graduate and undergraduate safety courses.

Another panel discussed the need for keeping the course materials up to date and ways in which this could best be accomplished. The material prepared by Northwestern represents a significant investment in time and resources and it is important that the investment be protected for as long as is practical. The potential value is great but it will be considerably diminished as technology changes. Much of the material was originally compiled between 1976 and 1978 and since the state of the art of safety is changing rapidly, some of the material needs to be revised. The modular fashion in which the course material has been assembled lends itself to an efficient updating process. At this time the recommendations of the faculty panel, along with several other alternatives, are being considered.

Initial feedback has indicated that most of the schools that received course materials plan to update and expand their existing course offerings at both the graduate and the undergraduate levels and at the same time to substantially increase the emphasis on highway safety. Several schools also plan to develop short courses by using this new material as the nucleus.

Although the primary objective of the special three-week session was to assist the faculty members in becoming familiar with the course materials, other important benefits will most certainly also be derived. Many of those who attended the session were leaders in the highway-safety research field as well as in the teaching field. This session provided an excellent opportunity for them to get together and exchange ideas with others who shared common interests and to become familiar with related work being performed that may have an impact on their own teaching and research activities. It was also anticipated that, by conducting this special session, the working relationship between FHWA and the educational community would be greatly enhanced.

CONCLUSIONS

The total cost of this project to FHWA from 1976 to 1980 was approximately as shown below:

Category	Cost ($)
Curriculum development, presentation of four 11-week sessions and one three-week session, and tuition, fees, and study materials	448 000
Living stipend grants for 66 eleven-week participants and 20 three-week participants	166 096
Duplication of materials for distribution through the College Curriculum Program	24 400
	638 496

The total cost to the government and to the taxpayers seems quite large at first glance. However, its significance is greatly reduced if we look at the potential savings possible through improved highway-safety programs.

Sixty-six students have attended the full 11-week sessions of the Highway Safety and Traffic Study Program and, as shown earlier in this paper, a high percentage have returned to assume responsible safety-related positions with their employers. To

that we must add the immeasurable but still predictable benefits of the three-week College Faculty Overview Session and of providing sets of the instructional materials to schools and other agencies through the College Curriculum Program. If we assume that each of the 60 schools now in possession of the course materials trains only 10 students, another 600 users will have been reached. It is expected that planned follow-up evaluations will yield a much higher total.

When this information is in the hands of such a large audience of potential users, it is expected that numerous improvements will be made in the safety of existing and planned highways throughout the nation. Since the attitude that seems to prevail now in this country is to "sue for all you can get" if involved in any sort of an accident, it is not uncommon for single highway-related accident settlements to exceed $1 million. If only one such accident and subsequent lawsuit against a public agency can be prevented, the taxpaying public will have been well compensated for the expense of this project.

ACKNOWLEDGMENT

Success of any project of this magnitude must by necessity be attributed to the ideas and dedicated efforts of many individuals. I served as contract manager for FHWA during the final year of the project and would like to express my appreciation to all who have contributed so generously, especially to Howard L. Anderson, formerly associate administrator of the FHWA Office of Highway Safety, who conceived the idea and gave full support to the program; to Donald S. Berry, Ronald Pfefer, and Joseph L. Schofer of Northwestern University, who served as principal investigators during the project; and to James L. Foley, Jr., of the FHWA Office of Highway Safety for his continued advice and guidance. Special recognition must certainly be given to Roger L. Dean, who served as contract manager for FHWA and whose dedication to the project helped ensure its quality and integrity, and to John Nitzel for his part in conducting the course as well as in finalizing the course materials. Technical advice given by many from within FHWA and the National Highway Traffic Safety Administration is appreciated, especially that from David Merritt, Harry Strate, Robert Winans, Webster Collins, James Iverson, William Blessing, Richard Richter, Rudolph Umbs, Seppo Sillan, and Douglas Syverson. Most important, the improvements initiated by the instructors from Northwestern University and the criticisms and suggestions offered by the participants themselves added greatly to the success of the project.

REFERENCE

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Railroad Engineering Education at the Undergraduate Level

RICHARD G. McGINNIS

At one time, courses in railroad engineering could be found in almost any civil engineering curriculum. Today, the opposite is true. As a result of the decrease in recruiting by the railroads during the 1950s and 1960s, emphasis in engineering education shifted away from railroads to other specialties. Because of the current growing interest in revitalizing the U.S. railway system, a few universities have begun to offer railroad engineering courses. During the decade of the 1980s, it is estimated that one-half of the railroad industry's current workforce and about two-thirds of top and middle management personnel will retire. The need for replacement personnel coupled with the increasing sophistication of railroad engineering activities has led to a growing need for highly trained engineers. To be most productive these engineers should have some education related specifically to railroads. Bucknell University has responded to this need by developing two courses and other educational activities oriented toward the railroads. The railroad education program at Bucknell has four objectives: (a) to stimulate student interest in the railroad industry, (b) to improve the student's understanding of the railroad industry and dispel common misconceptions, (c) to teach the fundamentals of railroad engineering, and (d) to discuss new concepts in railroad engineering and management. So far, response to the program from both the students and the railroad industry has been good. The university plans to continue improving the program as resources permit.

At one time, courses in railroad engineering could be found in almost any civil engineering curriculum in this country. Today, the opposite is true. In the 1950s and 1960s there was a decrease in recruiting on college campuses by the railroads; the result was that the emphasis in engineering education shifted from railroads to other specialties. With the exception of a few isolated courses and programs, the colleges and universities in the United States are no longer preparing engineering graduates specifically for entry into the railroad industry. This trend is in marked contrast, for example, to the 53 accredited undergraduate programs in aeronautical or aerospace engineering that were documented in the 47th Annual Report of the Engineer's Council for Professional Development (Sept. 30, 1979).

As the emphasis in engineering education shifted away from railroads to other specialties, the normal basis for the continuing evolution of courses and programs disappeared. Faculty interest shifted; courses were discontinued; no new textbooks were written. In the 1960s and early 1970s, the educational community was virtually isolated from the railroad industry.

With the current growing interest in revitalizing the U.S. railway system, a few universities have started to offer courses and conduct research in railroad-related areas. Although some progress has been made, it is difficult and expensive. As a result of the almost complete break in continuity of faculty and course development, the colleges and universities face a most difficult challenge.

NEED FOR RAILROAD EDUCATION

During the decade of the 1980s, it is estimated that one-half of the railroad industry's current workforce will retire and that between two-thirds and three-fourths of the top and middle railroad management personnel will have to be replaced (1). Although railroads have not had much difficulty in hiring the quantity of personnel they need, they have had some trouble in filling certain engineering positions. An associated problem experienced by some railroads is high attrition among young engineers during their first few years with the company.

Many engineering graduates do not even consider the railroad industry as a possible career. Some of these graduates have the false impression that the U.S. railroads have met the same fate as the passenger trains and that most, if not all, railroads are bankrupt or near bankruptcy. Others are repelled by the industry's image of conservatism, inflexibility, and antiquity. Some look toward other industries for jobs after hearing horror stories from recent graduates who are working as track supervisors and performing endless hours of work without relief or overtime compensation. Students must be properly informed about the railroad industry if they are to make suitable employment decisions.

Since the railroads have existed for two decades without university curriculum offerings in the railroad area, one might question the need for any special railroad engineering courses. However, changes are taking place in the industry today that will make it increasingly difficult for the railroads to keep pace with technological advances if they are forced to rely solely on the various means of on-the-job training that they have used over the years.

Many sectors of the railroad industry are rapidly increasing the sophistication of their operations. Within the engineering departments, advances are occurring that will, within the next decade, drastically change the day-to-day operations of the engineer. Many of these changes are predicated on the expected increased use of the computer for cost accounting, capital planning, and manpower and equipment management. Railroad engineers will soon be able to make decisions based on reliable data rather than on merely years of experience. Some railroads have already implemented computer-based management information systems that are used for maintenance-of-way (MOW) planning, maintenance equipment management, maintenance personnel management, and budgeting. Others are using the newly available information on maintenance costs and operating statistics to perform value engineering studies on the various components of the track structure.

The design, implementation, and operation of these new engineering computer models require a specialized education that can be obtained from railroad engineering courses at the college level. In the future, deregulation of the railroad industry and fiscal and energy constraints will only serve to heighten the demands on engineers for more-sophisticated solutions to the engineering problems of the railroads.

It is the belief at Bucknell University that the major need for railroad education is at the undergraduate level rather than at the graduate level. This feeling has been confirmed by numerous persons in the railroad industry and is a finding of the recent study of the educational needs in the railroad industry conducted by the University of Tennessee (1). It is also encouraging that the University of Tennessee study has recommended that federal assistance be provided to aid railroad education in four possible forms: (a) short courses, (b) curriculum enrichment, (c) university research, and (d) fellowships. This paper is concerned primarily with the second form--curriculum enrichment.

UNDERGRADUATE RAILROAD ENGINEERING EDUCATION AT BUCKNELL UNIVERSITY

Since the fall of 1976, Bucknell University has been developing educational activities related to the railroad industry. Initial interest came from the College of Engineering, in which courses have been initiated in the departments of both civil engineering and mechanical engineering. More recently, the Department of Management has shown an interest in incorporating railroad material into its curriculum.

During the development of the railroad program, Bucknell has maintained close contact with the railroad industry, which includes operating railroads, railroad suppliers, railroad consultants, the Association of American Railroads (AAR), the American Railway Engineering Association, and the Federal Railroad Administration (FRA). These organizations have been very supportive of Bucknell's program development and have given valuable direction.

The philosophy of railroad education at Bucknell is best described by a list of the program's objectives:

1. To stimulate student interest in the railroad industry,
2. To improve the student's understanding of the railroad industry and dispel common misconceptions,
3. To teach the fundamentals of railroad engineering, and
4. To discuss new concepts in railroad engineering and management.

The program is not intended to be a mechanism for recruiting personnel for the railroad industry. Although it is anticipated that some students may elect to pursue careers related to railroads, the main purpose is to give them a clear understanding of the railroad industry and its role in providing transportation services.

Stimulating Student Interest

Stimulating student interest in a subject is always an important ingredient in effective teaching. In the case of railroad engineering, it is difficult to get the students to consider the subject matter seriously because this requires convincing them that the railroad industry is a viable career option. Once the students realize that railroad engineering involves more than building model-train layouts, the romanticism of railroads is usually enough to sustain the students' enthusiasm through the course work.

One way to stimulate interest is to incorporate railroad examples into other engineering courses so that students are frequently encouraged to think about railroads. For example, at Bucknell, freshmen in an introductory engineering design course have used simulation to model a classification yard, sophomores in the required civil engineering computer course have written FORTRAN programs to compute train resistance, and juniors have designed rail sidings in their transportation engineering course and have analyzed various rail-related problems in their engineering economy course.

Publicizing the course offerings in the railroad area is important since none of these courses is required. Bulletin boards that display color photographs of railroad operations have been useful, but the most effective stimulus has been the positive

feedback about the courses from former students. Interest in railroad engineering is further developed by having qualified personnel from the industry talk to the student chapters of the engineering professional societies.

Understanding the Railroad Industry

Before beginning with the fundamentals of railroad engineering, it is necessary for the student to understand fully how the railroads fit into the overall transportation picture. This involves looking at the modal characteristics that make railroads extremely efficient for certain types of traffic and inefficient for other types. The role of government in railroad regulation is an important area to cover to give the student a good idea of the environment within which the railroads must operate. Work rules and railroad unions and their impact on the operations of the railroads are discussed. Finally, the history of the railroads and the reasons why the industry is today in a financial condition that is less than optimum are reviewed and the current problems that confront the industry as well as future circumstances that will affect its prosperity are discussed. In summary, an attempt is made to give the students an understanding of the railroad industry's strengths, weaknesses, and potential future.

Another aim of the activities at Bucknell is to provide as much opportunity for direct contact with the railroads as possible. In the formal courses, field trips are arranged to visit various railroads and suppliers to inspect such facilities as a classification yard, a piggyback terminal, a major locomotive repair area, a rail-car manufacturing plant, a rail-fabrication mill, a tie-treatment plant, automated trace renewal, and the track-laying system of the National Railroad Passenger Corporation (Amtrak) in the Northeast Corridor. Bucknell is fortunate in that all these facilities are within easy driving distance and class sizes are small enough to make these trips feasible. The importance of field trips in the educational process cannot be overemphasized.

In addition to the field trips, speakers from the railroad industry are invited to the campus to meet the railroad classes. The speakers have ranged from recent graduates who are working for a railroad to the chief executive officer of a major railroad. The presentations are usually informal and allow maximum interaction between the speaker and the students. Although some of the topics have been technical, most have been aimed at providing information about opportunities for young college graduates in the railroad industry.

Excellent opportunities exist in the industry for talented young people; however, not all would be happy working for a railroad. The management philosophies of some railroads regarding employee relations are not what some graduates desire in a job. Many railroad jobs are rugged; they require strong dedication from the employee. In order to acquaint the student with the nature of the work in the railroad industry, contacts have been made with various railroads to place students in summer jobs. To date, six railroads have hired Bucknell students for summer employment. After working for two or three months with a railroad, the student has a much clearer understanding of railroad work conditions.

In addition to the above activities, Bucknell's unique voluntary noncredit January intersession program has been used to a limited extent to allow students to gain valuable hands-on knowledge of railroad operations and regulations. Each year, two or three Bucknell students spend January working in Washington, D.C., for FRA. The students have worked on various projects for the agency in either the Office of Research and Development or the Office of Policy and Program Development. A pilot program to have a student work with a railroad in January was initiated in 1978; however, the record snowfalls and cold temperatures during that month made it impossible for the sponsoring railroad to find the personnel necessary to work with the student. Any future attempts at such a program will be made with railroads that operate in warmer climates in January.

Teaching Fundamentals of Railroad Engineering

Currently, Bucknell has two formal courses in railroad engineering: one in civil engineering and the other in mechanical engineering. These courses are directed toward upper-level undergraduate students but are open to graduate students with the provision that additional work be done.

The railroad mechanical engineering course covers two main topics: (a) the train as an energy system and (b) freight-car and passenger-car force analysis and design. In the first part of the course the energy aspects of train operations are examined. The factors that affect power requirements, such as the various types of resistance (e.g., rolling, track, bearing, air, curve, and grade), are studied in relation to the tractive-force capabilities of locomotives and the subsequent acceleration and velocity characteristics of the train. Diesel and gas-turbine power-plant performances are examined and compared with the performances of the heat engine and electrical machinery. Thermal efficiency and tractive effort of various throttle settings are studied for diesel-electric locomotives. Comparisons of fuel consumption per ton-mile (or passenger-mile) are made for different power plants under various operating conditions, such as changes in velocity, grade, curves, and acceleration.

In the section of the course on rail-car analysis and design, the forces that act on the car and its various components are examined under static and dynamic conditions. Results of the AAR and FRA track train dynamics research program are used here. In the analysis and design of components (e.g., wheels, bearings, couplers, and cars), material strength and safety factors are discussed in relation to static and dynamic loading requirements.

The lectures in the course are supplemented by guest speakers and field trips. In addition to assigned readings, the students are given design problems and laboratory projects throughout the semester.

The railroad civil engineering course covers four main areas in addition to the introductory material on the nature of the railroad industry: (a) train operations, (b) geometric design, (c) track structure, and (d) MOW operations.

In the train-operations section, students are exposed to the operational strategies of terminals and classification yards as well as to line-haul operations. Time-space diagrams are studied as well as railroad timetables and operating rulebooks. Various blocking and centralized traffic control strategies are discussed in relation to track capacity. The students are also introduced to train resistance, tractive effort, and locomotive power principles. In the near future these topics will probably be expanded into a separate course on railroad operations.

The civil engineers learn about basic geometric design in their required transportation engineering course, so emphasis in the railroad course is placed on transition spirals and turnout design. The students do several laboratory design projects in

this section on turnout, crossover, and siding design by using the Coordinate Geometry System (COGO) interactive computer graphics program to verify calculations and to produce drawings.

The functions and the design of the components of track structure--i.e., rails, crossties, ballast, and subgrade--are discussed individually and as a system. Much of the material for these topics is taken from current railroad publications and recent research reports, in particular from the Facility for Accelerated Service Testing (FAST) project.

Because of the importance to the civil engineer of MOW operations, it is necessary to give the student some background in this subject. Unfortunately, many of the day-to-day MOW operations are difficult to teach in a classroom and can be learned best in the field. Thus, in the lectures, topics related to the management of MOW operations such as MOW planning models, engineering data bases, and FRA track classification and safety standards are stressed. MOW tasks (surfacing, undercutting, stringlining, timbering, grinding, etc.) and MOW equipment are described to the students by using color slides and a few field trips to inspect actual MOW operations.

Introducing New Concepts

Within the last few years, large commitments have been made to railroad research by the federal government and the railroad industry. At Bucknell, it is felt that it is very important that students be made aware of the findings of this research, since there is some evidence that these results are being implemented at a fairly slow rate in certain sectors of the railroad industry.

Much of the exposure to these new concepts is accomplished by the professor in the classroom lectures. However, each student is required to study at least one topic in depth and to write a paper and to present a seminar on the subject. In addition to exposing the student to current research, this exercise enhances the student's oral and writing skills.

Whenever possible, students are encouraged to work on research projects that are under way in the department. The amount of sponsored research at Bucknell is modest since the education of undergraduate students is the university's primary objective. Consequently, Bucknell is selective in the type of research projects it seeks. The type of projects consistent with the general objectives of the university and the specific objectives of the railroad program are those that allow undergraduate students to learn more about the operations and problems of the railroad industry.

Students are encouraged to develop their own research topics related to railroads and may earn course credit for their efforts. In addition to individually sponsored student research, civil engineering students have the opportunity to increase their railroad education by selecting a railroad-related topic for their required senior design project. This project, which is equivalent to approximately 5 semester-h of effort, begins in the fall of the student's senior year with a feasibility study. The feasibility study is extended into a detailed design during the spring semester.

RESPONSE TO THE PROGRAM

Student response to the program has been good. At a school the size of Bucknell (total enrollment, 3200; engineering enrollment, 650), large numbers are not encouraged for any specialized area. Over the last three years, approximately 25 percent of the civil engineering students have elected to take the railroad civil engineering course. Class size has been about 10 students, which is an optimum size for class field trips and good classroom discussions. Enrollment in the railroad mechanical engineering course has been lower.

Student evaluation of the courses has been very good, which reflects, in part, the students' enthusiasm for the numerous field trips. In general, the students feel that the courses have given them a much better understanding of the railroad industry and have provided them with interesting material that they would otherwise never have seen.

The railroad industry's response has also been good. In addition to support in the form of guest speakers, teaching materials, and field trips, the railroads have provided opportunities for both summer and permanent employment. Currently, four railroads send recruiters to the campus and several others solicit student applications for employment. The overwhelming response from the railroads coupled with the generally high demand for engineering graduates has resulted in a demand for railroad engineers that far exceeds the supply that Bucknell can provide. Over the last several years, about 10-15 percent of the civil engineering graduates have accepted jobs in the railroad industry, and about two or three times as many students were offered employment by the railroads.

PROBLEMS IN DEVELOPING RAILROAD ENGINEERING COURSES

Developing the railroad engineering courses at Bucknell has not been an easy task. As was stated in the introduction, universities have been somewhat isolated from the railroad industry for two decades. Consequently, experts in railroad engineering are difficult to find in the academic community. The latest comprehensive textbook on railroad engineering is by Hay (2), which was copyrighted in 1953.

The two greatest obstacles to developing railroad engineering courses at Bucknell were finding appropriate teaching aids and retraining faculty. Neither of the faculty members involved in the two railroad engineering courses had any specific experience in railroad engineering. Over a period of four years, these professors have developed the courses and their own backgrounds in railroad engineering through summer employment in the railroad industry and an extensive program of self-study. A sabbatical for one professor and released time from teaching responsibilities for the other professor along with travel funds for both to visit railroads and suppliers were contributed by the university. Since neither suitable textbooks nor lectures notes were available, teaching materials had to be developed topic by topic from whatever sources the professors could find. Current railroad periodicals and research reports were the most useful sources. These articles were supplemented by material from railroads and railroad suppliers and slides taken during visits to railroad properties.

At this time, it is safe to say that the courses are still in the development stage. Each year, additions are made to the lecture notes as more information becomes available. In the civil engineering area, sufficient material has been gathered to expand the original course into two--one in railroad operations and another in design and maintenance of track. However, without released time supported through external funds, this development will take several years.

CONCLUSIONS

The results of the four-year effort to introduce

railroad engineering into the undergraduate education program at Bucknell have been encouraging. It is felt that the future of the railroad industry is good and offers excellent opportunities for young college graduates. Bucknell plans to do as much as possible within limited fiscal constraints to continue the development of activities in the area of railroad education.

At this time, future plans are to increase Bucknell's involvement in sponsored research related to the railroad industry, to continue improvement and expansion of the current railroad engineering courses, and to extend the railroad offerings to the Department of Management.

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Cooperative Training Programs for Undergraduate Students

C.S. PAPACOSTAS

This paper describes the structure, operation, and accomplishments of a training program for undergraduate students undertaken cooperatively by the University of Hawaii and the Honolulu Department of Transportation Services with funding support from the Urban Mass Transportation Administration. The program consisted of a combination of activities that included practical student training, interactively conducted applied research, and a seminar series in public transportation. Recommendations are included that will, it is hoped, be useful to those contemplating similar efforts.

The derivation of mutual benefit from improved communication between universities and the transportation profession is a matter of increasing concern. The need for cooperation has been emphasized in relation to the utilization of the products of university research. In this case, the lack of involvement of the intended users throughout the research process has been identified as a critical barrier to technology transfer (1).

Recent conferences on engineering education have also recognized that the delivery of education and training programs stands to gain from a closer interaction between theory and practice. This is especially true in the case of undergraduate training in which the benefits of traditional university research are indirect and, according to a recurring theme advanced by employers, irrelevant to the demands of the entry-level positions sought by these students after graduation. University departments that emphasize undergraduate education are most sensitive to this need.

Efforts to increase the involvement of undergraduate students in the operational aspects of transportation and to enhance the interaction between the Civil Engineering Department of the University of Hawaii and the local professional community began in 1973 and led to the award by the Urban Mass Transportation Administration (UMTA) of an innovative research and training grant (provided by Section 11 of the Urban Mass Transportation Act of 1964, as amended) for the period beginning September 1, 1977, and ending August 30, 1978. Subsequently, a second grant was awarded for a study that was conducted from September 1, 1978, to June 30, 1980 (including a no-cost extension).

Although smaller in scope, these programs were similar to the program grants that were initiated later by UMTA. These programs can be described as a hybrid between traditional agency-administered work-study undertakings and typical university-based research projects. They were undertaken in cooperation with the Honolulu Department of Transportation Services (DTS) and consisted of a combination of activities that included practical student training, interactively conducted applied research, and a seminar series in public transportation that was attended by students and faculty, practicing professionals from the public and private sectors, elected officials, members of citizens' advisory groups, and the general public.

The purpose of this paper is to describe the operation and accomplishments of these cooperative programs and to offer recommendations that will, it is hoped, be useful to those who contemplate similar efforts.

EARLY EFFORTS

During the academic year 1973-1974, the civil engineering students enrolled in the junior-level introductory transportation course were assigned the task of participating in a DTS project by taking passenger counts and conducting on-board surveys on two peak-period express-bus routes. Faculty members assisted in the design of the survey questionnaire and assumed the responsibility of scheduling and overseeing the collection and analysis of data (2). Virtually all the juniors in the civil engineering program that year were thus exposed to patronage surveys and the information that can be derived from such surveys. A similar project, concerned with a survey of what proportion of bus patronage consisted of fare-paying adults, students, the elderly, and the handicapped, was conducted in 1978 (3).

A major consequence of the original project was the part-time employment of six students in the spring of 1974. Their work consisted of collecting ridership data on the countywide bus system. In the meantime, efforts to establish more-formal cooperative programs resulted in the hiring of five student

interns in a program that lasted until June 1976. This program was administered by the Honolulu Civil Service Department under an existing public administration internship agreement between the city and county of Honolulu and the University of Hawaii. Funds were provided by DTS, and the university only monitored the academic performance of the students and had no formal input into the work program itself.

Similar efforts to place students as interns in local agencies were undertaken between the Department of Civil Engineering and the state of Hawaii Department of Transportation (HDOT). This resulted in the hiring of 16 students for one year beginning in September 1976. The interns were placed with various HDOT divisions and given subentry-level engineering assignments in the areas of planning, design, and construction under the supervision of HDOT personnel. This cooperative program is still in existence and involves approximately 20 students each year. The state program is both funded and administered by the cooperating agency and, as is the case with the city and county programs, university participation consists of maintaining and updating lists of eligible candidates.

This type of cooperative program is useful in the sense that it satisfies specific agency needs and provides some training for the students involved. However, individual student assignments are generally simple and brief and in many instances lack continuity and relevance to a well-rounded undergraduate academic program. The need has been recognized for an externally funded program that incorporates more-direct university involvement while it maintains the responsiveness of earlier efforts to agency needs. This has led to the award of the two UMTA-funded programs described in this paper.

UMTA-FUNDED PROGRAMS

The major thrust of these programs was the enhancement of the educational experience of undergraduate students by engaging them in a sustained training activity that paralleled the problem-solving process, beginning with problem identification and ending with the preparation of a final report.

The earlier cooperative efforts described above and subsequent discussions with the staff of DTS revealed the possibility of identifying a number of research areas that were complementary to the agency's activities but were not part of its work agenda because of manpower and other constraints. The undertaking of these research projects was considered to be desirable for both the agency, which could use the results of such projects, and the students, who could benefit from a more-realistic set of activities than mock academic exercises. However, it was understood that, unlike typical university research projects, the major emphasis was to be placed on training and that, when necessary, some project progress efficiency would be sacrificed for the sake of stressing the learning aspect of the endeavor.

A seminar series that featured guest lecturers from the local area as well as from the U.S. mainland was added to the proposed program. The purpose of the series was to complement the training component of the program and to provide an opportunity for the professional development of the agency's staff through the sharing of knowledge about contemporary developments in the field of transportation. The need for such technical interchange at the staff level is particularly felt in Hawaii because of its geographical isolation from the rest of the nation.

Program Operation

A committee of faculty principals and representatives from the various divisions of DTS was established to evaluate applications and interview and select trainees and to identify the general areas of concentration. At this stage, detailed project activities were left open, to be specified following a clearer assessment of the trainee's capabilities and educational needs as well as the availability of resources. The following criteria were applied to the selection of project areas: (a) satisfaction of short-term agency needs and (b) compatibility with the academic program.

The list of projects eventually undertaken includes the following:

1. Transportation of the elderly and the handicapped: Analysis of the profiles of eligible and actual users of Honolulu's Handi-Van system;
2. Transportation safety: An inventory of the agencies involved in the local safety program, the types of data collected, and the type of storage and retrieval methods employed;
3. Moped use: A description of legislative background, legal definitions, rules and regulations, and analysis of moped use to determine recreational purposes, user perceptions, and accident patterns;
4. Reactions to a bus transit mall in the central business district (CBD): Investigation of the reactions of the CBD daytime population toward a bus transit mall and that population's perceptions of the mall's impacts;
5. Bus-stop surveys: A series of surveys of bus users conducted at major bus-stop locations;
6. Demand-responsive scheduling: Literature review of existing algorithms and tabulation of their characteristics; and
7. Simulation of bus transit mall: Development of a simulation model to be used in the analysis of various operational and control strategies.

Student Training

A total of 14 students (mostly juniors and seniors) took part in the programs. Their participation was concurrent with a full academic load that absorbed approximately 20 h/week during the academic semesters and 40 h/week during the summer. Each student received a prescribed stipend. The typical trainee remained in the program for a full year.

The training program consisted of two interrelated phases. During the first phase, the trainees were assigned in pairs to the designated project areas, were provided space at the appropriate sections or divisions of the agency, and were given full access to the resources available there, including the agency staff. The degree of personalized attention given to the students by the agency staff in most instances exceeded prior expectations. This degree of commitment on the part of DTS, not only at the administrative level but also at the staff level, contributed greatly to the success of the program. The role of the faculty during the first phase was mainly as follows:

1. To maintain contact with the responsible DTS personnel in order to monitor the students' progress;
2. To aid in the design of student assignments;
3. To conduct a weekly plenary project meeting at the university at which students discussed their progress, exchanged information, and received instructions; and
4. To work closely with agency personnel in order

to define the precise nature and scope of the research projects.

The aims of this phase were to orient the students to the institutional and operational aspects of transportation planning by working closely within the planning agency; to familiarize the students with the contextual, historical, and policy character of their respective problems; and to provide the foundation on which to build later project activities. These aims were accomplished by concentrating on the following areas:

1. Problem area description;
2. Federal policy background;
3. Local response, including legislative actions, assignment of institutional responsibilities, and formulation of transportation strategies and implementation of specific actions (this effort exposed students to other agencies involved and resulted in the acquisition of an improved overall planning perspective); and
4. Investigation of local data sources (much relatively unused information was discovered, which strongly influenced the shaping of subsequent project activities).

In addition, the students helped the agency by performing on-going projects outside the scope of their project areas. For the most part, the students helped in the taking of surveys.

During the second phase, the day-to-day supervision of the students shifted to the university in accordance with the provisions of the program grant. The students' need for increased accessibility to the faculty and to other university resources (such as the Computer Center) caused their transfer to the campus. In addition to daily contact between students and faculty, plenary project meetings were held more frequently than before.

Interaction with DTS was maintained in two ways. The students continued to contact the DTS staff and that of other agencies when specific project needs arose, and the faculty met frequently with agency staff to report on the progress of the projects and to discuss modifications in the project tasks. Interim project findings were also transmitted to the agency for their immediate use.

The training emphasis was maintained by explicitly devoting time and other resources to the development of student skills in using research-related tools. For example, the trainees were encouraged to attend a series of short courses presented by the university's Computer Center on the use of available computer packages such as the Statistical Package for the Social Sciences.

In addition to the seminar series, the trainees were also encouraged to attend meetings of transportation-related organizations. As a result, two students were accepted as members of the Citizens' Advisory Committee of the Oahu Metropolitan Planning Organization.

Utilization of Results

The findings of the projects were immediately available to DTS and to other organizations. Project reports provided useful information that was incorporated into studies undertaken by agencies and their consultants. Requests for the reports were received from other universities and various planning and operating agencies throughout the nation and, to use traditional university criteria, papers based on the reports were presented at conferences and appeared in professional publications (4-6). The experience to date indicates that benefits from the program will continue to accrue in the future.

Seminar Series

A major component of the programs was the presentation of a seminar series in public transportation. As originally envisioned, each seminar was to consist of a presentation on campus by a guest lecturer followed by a discussion period. However, when the first seminar was being arranged, it became clear that interest in the series was considerably more widespread than expected.

Agencies and other institutional entities expressed a desire not only to attend the seminars but also to meet the guest lecturers during their stay in Honolulu. Individuals, especially those from neighborhood boards and other citizens' advisory committees, also responded enthusiastically. Numerous suggestions for seminar topics and speakers and some proposals for cosponsorship were received.

In order to accommodate these interests, the seminar agenda was expanded from programs that contained a single presentation to half-day affairs that featured a mainland speaker whose presentation was complemented by those of persons from the local area. In addition to their presentations at the seminars, the mainland speakers met with various transportation-related groups to discuss issues of local importance. Some speakers agreed to participate in as many as three such meetings, which involved planners from public agencies, state legislators, city council members, and invited guests.

As far as the general community was concerned, the seminar series became the most visible component of the program. Audiences ranged from about 40 to as many as 250 and were drawn from the university and practically all transportation-related public agencies, decision-making institutions, professional and business organizations, and citizen groups. The presentations by 10 mainland speakers were complemented by 27 presentations by 18 speakers from the local area.

A brief description of each of the seminars in the series follows:

1. Transportation for the handicapped: Presentation of Denver's Handy-Ride system and local efforts by city and state agencies, including Honolulu's Handi-Van system;
2. Public transportation: Discussion of the range of transportation options available to urban areas;
3. Current trends and issues in public transportation: Contemporary concerns, which included political decision making, rail transit and urban development, transportation systems management, and ethics in decision making;
4. Planning for rapid transit: History of mass transit in Atlanta, Georgia, and the events that led to the formation of the Metropolitan Atlanta Rapid Transit Authority (MARTA); the role of transit authorities; financing; public referenda; and citizen participation [also featured were studies of the development potential around the stations included in proposals for a Honolulu Area Rapid Transit (HART) system];
5. Federal, state, and local government roles in urban transportation: Presentations by federal, state, and local officials that included the National Rail Transit Policy being circulated at that time;
6. Labor aspects of urban mass transportation: Policy and budget effects of labor negotiations on part-time drivers in Seattle and bus system operation through a management contract (i.e., the mode of operation of the Honolulu bus system); and

7. Integration and brokerage of urban transportation services: Description of options, organizational structures and financing arrangements, cost and service implications, labor relations, and case studies.

DISCUSSION

After reflection on the overall experience described above, two major areas should be considered when the establishment of cooperative training programs is contemplated--institutional considerations and the need for program flexibility.

Institutional Considerations

In fashioning the envisioned programs, it was necessary to consider the structure and orientation of the cooperating institutions explicitly. The fundamentally different objectives of the local agency, which is oriented toward its on-going projects, and the academic institution exerted opposing pressures during the formation of project activities.

Notwithstanding the personal commitment by individual staff members to the training of students, the institutional emphasis on the agency side was placed on tangible products. A tendency toward the use of students as in earlier arrangements became evident.

On the university side, individual faculty members enjoy relative freedom in selecting their academic activities. However, the level of effort required by the kind of program described in this paper is likely to be underestimated by some of the faculty and by university administrators. The former judge it lacking in comparison with traditional university research and the latter perceive it as requiring minimal university participation. These are understandable normative judgments that should be expected when the conduct of an unusual program is contemplated within an existing institutional framework. To use a trivial example, some difficulty was encountered in determining whether the programs should be placed under the administrative auspices of the university research program or under the auspices of the training units; the training unit was chosen.

In this connection, it should be stated that it is not the intent of this paper to argue that the programs it describes are intrinsically superior to other research and training arrangements. Rather, they are presented as legitimate options that address special needs and are quite capable of existence within the mixture of academic activities.

Flexibility

The program emphasis on training, the differing institutional perspectives, and an anticipated learning-curve behavior dictated the need for considerable program flexibility.

The selection of specific projects, for example, was highly dependent on the needs and capabilities of the participating students. To accommodate their diverse needs and to be responsive to changing agency needs, the program proposal specified a number of mutually defined areas of concentration but left the selection of specific projects open. However, a committee of faculty members and agency personnel was established for selecting trainees and project activities and for ensuring the continuity of the overall program. Generally, the projects selected were relatively small in scope and, most importantly, complementary to rather than competitive with projects on the agency's agenda that were undertaken either in house or through the use of consultants.

SUMMARY AND CONCLUSIONS

There exists a need and an opportunity to improve undergraduate education in public transportation by combining theory and practice through cooperative programs. The programs described in this paper emphasized practical student training, permitted the conduct of a series of small-scale projects that addressed the needs of a cooperative public agency, and presented a well-attended seminar series in public transportation. The UMTA-funded programs facilitated direct and continuous interaction between the University of Hawaii and the Honolulu DTS and permitted a considerable amount of flexibility in the selection of project activities in order to be responsive to the needs of the students, the participating agencies, and the university.

The programs consisted of two essentially independent components--a unified training-and-research element and a seminar series. Because of its overwhelmingly good reception by the professional and general communities, the seminar series was considerably expanded from its original design.

The training-and-research component placed primary emphasis on the training aspect but also produced immediately usable results. This was accomplished by directly involving the university and the agency in the entire process.

The programs succeeded in (a) enhancing the education of 14 students, (b) providing products of immediate use, (c) providing a forum for an open dialogue on public transportation issues that face the community, and (d) strengthening the ties between the university and the professional community.

The lessons learned from the experience include the following:

1. The programs showed that a seminar series and a unified training-and-research program that specifically involves undergraduate students are capable of meeting local needs not otherwise satisfied. However, it is not necessary that the two endeavors be part of a single program.
2. To be independently justifiable, a seminar series should address issues of wide community concern, and special efforts to attract a diverse audience should be made.
3. An explicit commitment to the training-and-research program should be sought from both the university and the agency. On the agency side, a commitment on the administrative level can impart a sense of program legitimacy to the staff.
4. Acceptance at the agency-staff level is crucial and should be established prior to the initiation of the program.
5. In order to enhance agency interest, the program should also be able to provide tangible products that are usable by the agency.
6. The fundamentally different institutional structures and objectives of local agencies and academic institutions should be expected to exert opposing pressures during the formation of program activities. The former tend toward the use of students for on-going agency projects that involve minimal university participation and the latter lean toward elaborate and relatively independent research endeavors.
7. A funding source such as UMTA's University Research and Training Program, which is external to both the university and the agency, can contribute to the establishment of an appropriate balance between the opposing tendencies mentioned above.
8. A certain degree of flexibility in the selection of program activities is also desirable.

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Overall Assessment of a Statewide Certificate Program in Transportation

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The Certificate Program in Transportation offered between 1977 and 1979 by the Consortium of the California State Universities and Colleges and the California Department of Transportation is described and analyzed. This program was intended for mid-level management employees and focused on the planning, design, operation, and management of public transportation systems. The program's curriculum design and mode of delivery are described; results of an evaluation based on perceptions of students, faculty, and administrators are reported; and lessons to be learned from the program's experiences are derived and discussed in terms of future efforts of a similar nature. Major conclusions include the following: (a) educational programs of this nature should be based on the sponsoring agency's specific organizational needs; (b) the course content and level of instruction should be based on the interests and capabilities of the students; (c) the mechanisms for delivery of courses should be as simple as possible; (d) specialized programs require specialized faculty, which may be a serious constraint; and (e) since innovative educational programs in transportation are apt to be expensive, organizations that wish to sponsor them should be willing to pay a premium price.

This paper describes and analyzes the Certificate Program in Transportation offered between 1977 and 1979 by the Consortium of the California State Universities and Colleges (CSUC) under a contract with the California Department of Transportation (Caltrans). Although its official statement of purpose was quite broad, the actual focus of the program was on public transportation. Its primary purpose was to assist Caltrans in its transition from a basically highway-oriented organization to a broad-based multimodal agency; it was to do this by broadening the perspectives of the Caltrans mid-level management employees by increasing their awareness of some of the issues involved in the planning, design, operation, and management of public transportation systems.

Although developed in cooperation with Caltrans and intended mainly for Caltrans personnel, the program was open to professionals from other agencies. Indeed, their participation was particularly desired since it was felt that Caltrans students would profit from exposure to the views of other transportation professionals.

The program consisted of a cycle of five three-unit courses to be offered over five 10-week sessions. The course descriptions, condensed from those in the consortium's 1978-1980 catalog, are presented below:

COURSE TS-400. Transportation Systems in a Contemporary Context

Modal characteristics and review of transportation technology, land use and transportation interaction, principles of transportation planning, introduction to transportation and traffic engineering, evaluating transportation system alternatives, local and regional transportation plans.

COURSE TS-410. Analytical Techniques in Transportation Studies

Study design, basic quantitative capabilities in problem solving, computer modeling in transportation, survey methodology, operations research in transportation, maps and graphics use in transportation analysis and presentation, environmental-impact analysis in transportation.

COURSE TS-420. Efficient Use of Existing Public Transportation Systems

Developing for more efficient use of transport facilities, economic strategies, management and control of motor vehicles, relation of roads to transit systems, providing for pedestrians and bicyclists, urban goods movement.

COURSE TS-430. Transportation System Functional Design and Development

Collection, distribution, and internal circulation services; routing, scheduling, and dispatching of transit vehicles; fare-collection systems and policies; passenger information systems and services; park-and-ride, shuttle-transit, and express-bus service; paratransit systems and implementation; application of effectiveness evaluation to transit strategies; rural transportation planning, systems, and implementation.

COURSE TS-440. Transportation Systems Operational Management

Transit system management procedures, techniques for

improving transit management efficiency, transit management and labor relations, policies and decision making in the transit industry, marketing transit services, maintenance practices.

A single cycle of instruction was offered at each of the following five locations: San Diego, Los Angeles, San Bernardino, San Francisco, and Sacramento. Near the end of the first cycle of instruction, an evaluation of the program was performed (1). Although the formal evaluation document recommended that a second cycle of courses be offered, Caltrans declined to fund the second cycle.

In this paper we describe the program and the planning that produced it, the results of its evaluation, and some of the lessons to be learned from its successes and failures. We discuss the program's curriculum design and the practicality of carrying out programs of this type.

CURRICULUM DESIGN

The Certificate Program in Transportation was proposed by the Caltrans Division of Mass Transportation (DMT), a headquarters-level staff unit whose primary role is to serve as a resource for advancing public transportation policy (2). The educational need perceived by DMT officials resulted from a shift in the mission of Caltrans to increase its responsibilities in the area of public transportation. In particular, DMT officials felt that many of the Caltrans mid-level managers lacked an awareness of and an appreciation for nonhighway modes and that perhaps they also lacked some of the skills and information needed to deal with them.

From the beginning, the program was conceived as being statewide in scope and involving some sort of academic credit--preferably at the graduate level. Even though the responsibilities of Caltrans in the area of public transportation vary considerably among the state's major metropolitan areas, it was decided to develop a uniform statewide curriculum. Delivery of the program, however, would be decentralized and would be administered at the local level through the training programs of participating Caltrans districts.

Since the proposed program was viewed as being academic in nature and as involving some sort of academic credit, it seemed appropriate that its official sponsorship be through some university. The Joint Center for Transportation Studies (JCTS), a San Diego-area organization that had previously studied educational needs for Caltrans, suggested that the Consortium of CSUC would be the appropriate sponsoring agency.

The CSUC system is one of three systems of higher education maintained by the state of California. (The other two are the University of California and the California Community College System.) The consortium is an extension program attached to the CSUC Chancellor's Office; its function is to coordinate and sponsor statewide external degree and certificate programs that are actually carried out by local campuses. The consortium appeared to be an ideal sponsoring agency for the Caltrans certificate program because of its degree-granting powers, its statewide scope, and the availability of CSUC campuses in each of the state's major metropolitan areas.

In accordance with normal consortium policy, academic planning for the Certificate Program in Transportation was carried out by an academic program committee. This committee started out as an ad hoc group composed of representatives of the consortium, DMT, the Caltrans Division of Administrative Services (which is responsible for statewide coordination of the Caltrans training programs), and transportation professionals from the San Diego area associated with JCTS. Later, this group was augmented by representatives of a variety of transportation-related disciplines (primarily faculty from CSUC campuses) who were invited to participate by the consortium.

In devising the course descriptions, the committee was guided by its understanding that graduate-level courses were expected and by the suggestions of the DMT representatives concerning course content. Also, at this point, the consortium considered the certificate program to be the initial step toward an external master's degree program, so certificate courses were designed to be compatible with such a program. In including specific topics in the courses, the committee relied primarily on its own wisdom as to what was important--little information was available to the committee concerning either the specific needs of the Caltrans districts or the interests and backgrounds of the prospective students.

The rationale for the course structure adopted by the committee was as follows: The first two courses (TS-400 and TS-410) were seen as the core of the program. They were supposed to be taught at an upper-division undergraduate level and would not count as credit toward the master's degree (should one be instituted). Their purpose was to spark the interest of the students and bring them up to date in the analytical techniques and terminology to be used in subsequent courses. In particular, the course in analytical techniques (TS-410) was expected to be a review course for most of the prospective students. The third course (TS-420) was a condensation of what had originally been a two-course sequence that focused on techniques for transportation systems management (TSM). The fourth course (TS-430) was to focus on the design and technical operation of transit systems, and the fifth (TS-440) was to deal with the management of transit systems. These last three courses were to be taught as upper-division courses acceptable for graduate credit.

The course descriptions developed by the academic program committee were intended as guides to instructors rather than detailed syllabi. It was expected that one of the ongoing functions of the committee would be to work with instructors in developing syllabi to ensure comparability among the different locations. In practice, difficulties and delays in staffing coupled with problems in interpreting student reaction to classes prior to the formal evaluation tended to undermine this effort. The content and level of instruction of the courses as actually taught depended mostly on the individual instructors and varied considerably from course to course and location to location.

PROGRAM DELIVERY

Administration

The Certificate Program in Transportation was carried out on a decentralized basis by participating Caltrans districts and CSUC campus extension programs. Local administrative responsibilities were shared by Caltrans district coordinators, who represented the district training officers, and by local program directors, who represented the campus deans of continuing education. Program directors and Caltrans coordinators shared responsibility for scheduling courses and recruiting faculty; in addition, the Caltrans coordinators were responsible for selection of students and for physical arrangements for the classes. At one point, JCTS was engaged to

market the program on a statewide basis to students who were not from Caltrans. Following the failure of this effort, however, the program directors became responsible for marketing the program locally.

Financial Arrangements

The primary source of funding for the certificate program was $90 000 provided by Caltrans through two contracts with the consortium. Officially, this money was to pay tuition of $60 per credit unit (the consortium's maximum rate) for a guaranteed minimum of 20 Caltrans students at each of the five locations. In order to fund the development of the program, Caltrans paid the consortium $15 000 in advance.

It was discovered early in the planning of the program that $90 000 was inadequate to fund development of the program and the implementation of the first cycle; actual expenses were expected to be on the order of $135 000. This meant that each location would have to enroll at least 10 more students. As it turned out, expenses were even greater than expected; at some locations it appears that an average enrollment of 35 students would have been needed to meet all expenses. In fact, only one of the five locations was ever able to attract 10 or more students other than those from Caltrans, and it was unable to retain this number through the full cycle of instruction.

The impact of the program's inadequate funding was felt mainly by the extension programs of the participating campuses. The budget for the program was developed to use funds provided by Caltrans to meet faculty salaries and the consortium's expenses. This left the overhead expenses of the campus extension programs and any unexpected expenses to be met by tuition from the students who were not from Caltrans.

Staffing

Professional personnel needed to operate the program included local program directors and faculty. Program directors were chosen by the campus extensions, and the faculty were then selected by the program directors and the Caltrans district coordinators. There were no uniform criteria for the selection of faculty, and procedures appear to have varied from site to site. Several of the campuses were unable to hire program directors who had experience in transportation; this and the lack of qualified prospects, the unattractive pay, the poor working conditions, and the lack of a systematic selection process created difficulties in attracting competent and well-motivated faculty.

It was originally assumed that most faculty--at least most of the instructors in charge of the courses--could be recruited from the participating CSUC campuses. At the same time, it was thought that, due to the considerable professional experience of the students, practitioners should also be used, at least as guest speakers. As the program progressed, it became apparent that there were too few on-campus faculty in transportation-related disciplines to adequately staff the courses and also that the students had difficulty in relating to academic instructors. Consequently, each local program tended to switch from the use of academic faculty to the use of practitioners. Recruitment of both academic faculty and practitioners was hampered by the normal recruitment policies of the consortium and the campus extensions, particularly their inflexible and comparatively low pay scales.

Faculty recruitment was further complicated by a lack of coordination with campus schedules and by a policy of not buying faculty time from the campuses because of the higher benefit rates involved. This meant that academic faculty as well as practitioners had to teach the courses in addition to their regular duties.

Finally, recruitment of guest speakers was hampered by the lack of funds specifically budgeted for that purpose. This meant that guest speakers had to be paid out of instructors' salaries or from operating budgets that were already badly strained.

Scheduling

The certificate program was planned to be offered at all five locations simultaneously. As the program progressed, however, no attempt was made to coordinate scheduling on a statewide basis. Most scheduling details were actually determined on a local basis by the program directors and Caltrans coordinators.

Classes were offered during working hours at locations provided by Caltrans. It was recognized at the planning stage that scheduling classes during working hours and identifying the program so strongly with Caltrans might discourage students who were not from Caltrans, but it was thought to be necessary if Caltrans was to guarantee minimum enrollments.

Selection of Students

Selection of Caltrans students was the responsibility of the Caltrans district coordinators. Despite a great deal of emphasis on program uniformity during the planning phase, no effort was ever made to provide statewide guidelines for student selection. Actual practices varied greatly, as did key characteristics of the resulting student bodies, especially their educational backgrounds. Selection procedures ranged from no screening at all to ordering certain employees to attend. The most common method, however, was to recruit students on a volunteer basis but by using some sort of screening.

One important aspect of the student selection process was the lack of any restriction against the enrollment as students by Caltrans employees involved in the administration of the program. Indeed, four of the five Caltrans district coordinators were so enrolled. This created a situation in which some instructors felt that their academic control of the classes (including their grading practices) was being undermined.

PROGRAM EVALUATION

The consortium's normal procedures require that all programs be evaluated annually. In accordance with this policy, the consortium commissioned an evaluation of the Certificate Program in Transportation. This evaluation was conducted during the spring of 1979, near the end of the first cycle of instruction. The evaluation was based primarily on the perceptions of students, faculty, and administrators in the program.

Evaluation Methodology

Information used in the evaluation of the program (1) was obtained from questionnaires administered to students and faculty and interviews with academic program directors and Caltrans coordinators. This information is summarized as follows:

1. Student questionnaire
   a. Student socioeconomic profile

Table 1. Mean assessment scores for individual courses and for overall program.

Location	Course Number: TS-400 N	TS-400 Score	TS-410 N	TS-410 Score	TS-420 N	TS-420 Score	TS-430 N	TS-430 Score	TS-440 N	TS-440 Score	Overall Program N	Overall Program Score
San Diego	14	2.19	14	4.00	14	1.57	14	2.07	14	2.36	14	2.71
Los Angeles	16	2.31	15	2.87	14	3.79	16	1.44	-	-	16	2.44
San Bernardino	9	2.67	10	3.00	10	2.50	-	-	-	-	10	2.90
San Francisco	16	3.25	17	1.94	17	1.53	17	1.53	-	-	16	2.25
Sacramento	12	2.17	12	2.75	12	2.91	12	2.91	-	-	12	3.00

Note: N = number of students enrolled for each course.

b. Student evaluation of course objectives for each course completed
c. Overall evaluation of instructional quality for each individual course completed
d. Perceptions concerning the entire five-course curriculum

2. Faculty questionnaire
a. Information concerning student performance and preparation
b. Attitudes concerning the strengths and weaknesses of the five-course curriculum
c. Attitudes concerning the appropriateness of course objectives for courses taught by the faculty member
d. Attitudes concerning class format
e. Information concerning faculty expertise and professional affiliations

3. Program directors and Caltrans coordinators
a. Procedures by which faculty were selected and recruited
b. Coordinative and cooperative efforts between the campus and the Caltrans district office
c. Association with the central administration of the consortium
d. Efforts to recruit students other than those from Caltrans for the certificate program
e. Fiscal and budgetary considerations
f. Substantive comments concerning the curriculum
g. Criteria for selecting participating Caltrans students

Other information used in the evaluation included course syllabi (when available), faculty vitae (when available), student grades, and documents that related to the program, such as the program proposal and memoranda of understanding among the various agencies involved.

Not all courses had been completed at all five locations at the time of the evaluation; consequently, more information was available for some courses than for others. Table 1 shows the locations at which each course had been completed by the time of the evaluation.

Caltrans representatives in each local office coordinated the administration of the questionnaire for Caltrans students. The other students were contacted through the central administration of the consortium. The response rate from Caltrans students was fair, averaging 66 percent overall, but it varied considerably from location to location (from a low of 39 percent to a high of 83 percent). Response from the other students was nonexistent; consequently, the views of these students could not be included in the evaluation. Administration of faculty questionnaires was coordinated through the program directors on each campus; response to these was relatively poor (8 responses out of 15 faculty who had completed a course at the time of the evaluation). With one exception, all program directors and Caltrans coordinators were interviewed.

Student Characteristics

Based on responses to the questionnaires, the typical Caltrans student who participated in the program was a white male in his middle 40s with a little more than 20 years of experience in the transportation field and about an equal number of years of service with Caltrans. Educational levels were quite variable. Statewide, 75 percent of the respondents were college graduates and 19 percent held master's degrees. The percentage of college graduates varied among the participating districts from 50 percent to 94 percent and the percentage of master's degrees from 7 percent to 31 percent.

Student Perceptions

Reaction of students to the certificate program on the whole was favorable but hardly enthusiastic. Students were asked to express their degree of satisfaction with the program on a numerical scale from 1 to 5, with 1 being most satisfied and 5 most dissatisfied. Table 1 summarizes the mean assessment scores for each course and location. The overall mean assessment scores ranged from 2.25 in San Francisco to 3.00 in Sacramento. It should be noted that the absolute values of the numerical ratings, both for the program as a whole and for individual courses, seem to have depended more on student attitudes and classroom dynamics than on course content or instructors. This is particularly clear in the cases of San Francisco and Sacramento, in which three of the four courses evaluated at each location had been taught by the same instructor.

Students were also asked whether they would have been willing to participate in the program under a variety of assumed conditions. Only 8 percent reported that they would have participated if they had had to pay full costs and if the courses had been held on their own time. Only 18 percent would have paid the full tuition if the courses had been on state time, and no more than 63 percent would have participated if tuition and books had been fully subsidized but the courses had been taken on their own time. Clearly, most students felt that the program had some value but did not feel that it was really worth what it cost.

Students were also asked to express satisfaction or dissatisfaction with individual courses, to rank the courses according to their value, and to state whether they felt that the courses contributed to their short-term and long-term professional goals. Reactions to instructors tended to be overwhelmingly important in the assessment of the courses; thus, no clear pattern of reactions to course content could be determined. This problem is compounded by the fact that course content and the level of instruc-

tion also depended heavily on the instructors; as a result, there was little consistency from location to location in the content and level of individual courses. On the whole, however, the more-practical courses (TS-420 and TS-430) appear to have been the most popular and the course in analytical techniques (TS-410), the least popular. The introductory course was moderately popular at most locations. The management course had been taught at only one location at the time of the evaluation; consequently, no conclusions could be drawn concerning it.

For the most part, student perceptions whether particular courses contributed to their professional goals were closely related to student satisfaction with the courses, which was reflected in the numerical assessment scores and the course rankings. There was an almost universal tendency to perceive courses as contributing more to long-term professional goals than to short-term ones.

The most striking feature of the students' reactions to individual instructors was that they preferred practitioners to instructors who had academic backgrounds. The students' reasons for disliking academic instructors varied. In some cases, there was a clash over the rigor of the mathematics used in the courses. Some academic instructors stressed modeling theory and mathematics, particularly basic statistics. Students tended to find these topics irrelevant to their daily tasks and to perceive these instructors as too theoretical. In other cases, however, academic instructors were perceived by the students as being not knowledgeable, in particular, as being not up to date. Also, students seemed to prefer an anecdotal style of teaching--a style more prevalent among practitioners than academicians.

Students' opinions were also sought on other issues related to the design and delivery of the certificate program. Since the program had originally been conceived as part of a master's degree program, students were asked whether they felt that academic credit for the courses was important. On a statewide basis, 45 percent responded positively; positive responses varied by location from a low of 20 percent to a high of 67 percent.

Other questions sought student perceptions about the mix of student backgrounds in the classes. This was considered important because exposure to professionals of varied backgrounds was included in the program proposal as an integral part of the educational experience. Most students felt that the mix of Caltrans students was adequate (81 percent statewide), but students were sharply divided from district to district over whether a more-extensive interagency mix of students was desirable. Positive response to this question ranged from a low of 33 percent in Sacramento to a high of 73 percent in Los Angeles.

Faculty Perceptions

Due to the small number of faculty who responded to the questionnaire, knowledge of faculty perceptions is somewhat sketchy. It appears that faculty perceptions of the academic preparation of students, their level of performance, the extent to which they carried out assignments, and their interest and motivation were quite mixed. This was especially true of student academic preparation; some academic instructors rated the students as very poorly prepared for graduate-level work, particularly in terms of their mathematical backgrounds. This appears to have depended more on the instructor's expectations concerning student backgrounds and on their concept of what was involved in graduate-level coursework than on the students' actual backgrounds. The two districts in which these comments were most pronounced, however, did have high percentages of students who were not college graduates.

With one notable exception, the mixed reactions of instructors to students were not reflected in the grading of the courses. Grade-point averages for individual classes (with the one exception) ranged between 3.14 and 3.96 on a 4-point scale. These averages seem to reflect the instructors' understanding that most, if not all, students were to receive A's and B's (because these grades are common for graduate education) and not the instructors' assessment of the overall performance of the class.

Faculty were also asked to comment on the overall curriculum design and on the administration of the program and were asked whether they would be willing to participate if a second cycle of instruction were held. Again, answers were mixed. However, it is striking that, despite the fact that some faculty members who responded to the questionnaire made very negative comments about various aspects of the program, all were willing to teach a second cycle.

Perceptions of Program Directors and Caltrans Coordinators

Program directors and Caltrans coordinators were asked about their relationship to one another and about their opinions regarding faculty, course content and curriculum, and financing of the program. In addition, Caltrans coordinators were asked whether the program should continue for a second cycle in their districts.

With one exception, program directors and Caltrans coordinators reported that there was good communication among them and that they worked together well.

Program directors' comments concerning faculty were mostly about the mechanics of recruiting faculty; besides describing the process of recruitment, several commented on some of the difficulties encountered. These included inadequate pay, inconvenient scheduling of classes, and lack of time for instructors who were working full time elsewhere to develop and teach classes.

Comments by program directors on course content and curriculum tended to be very sketchy. This was to be expected since several were not familiar with the transportation field.

Comments by Caltrans coordinators concerning faculty, course content, and curriculum tended to reflect student perceptions. This is hardly surprising, since four of the five coordinators were also students in the program.

Both program directors and Caltrans coordinators strongly disapproved of the financial arrangements for the program. It seemed to be unanimous that the JCTS marketing contract was a mistake. Also, most program directors and coordinators questioned the need for continued involvement by the consortium and expressed a preference for direct arrangements between local Caltrans districts and campus extension programs. The recommendations of the Caltrans coordinators concerning continuation of the program varied: One coordinator recommended that the program be dropped, another recommended that it be continued but not immediately, and the other three recommended continuation. These recommendations seem to have been based primarily on the existence (or lack thereof) of unmet demands among prospective students in their districts and not on their opinions concerning the quality of the program.

LESSONS LEARNED

Previous sections have described the planning and

delivery of the Certificate Program in Transportation and reported the results of an evaluation sponsored by the agencies that provided it. In this section we will discuss the lessons of general applicability that can be drawn from the experiences of the certificate program. We will focus on (a) the format and content, (b) the mode of delivery, and (c) the practicality of programs of this sort.

Format and Content

The question of whether the format and content of the program were adapted to Caltrans' needs is difficult to answer, primarily because the need for the program was never stated in very specific terms. The need for the program was presumably created by a broadening of Caltrans' mission to include responsibilities in the area of public transportation. It is certainly plausible that this shift in mission affected the responsibilities of Caltrans' mid-level managers. It might have (and probably did) create a need for new attitudes (the broader perspectives referred to previously), and it may also have created a need for new skills or new information.

The appropriateness of the program's format and content depends on the extent to which each of these needs was important. The content of the program was geared primarily toward teaching skills (especially analytical skills) and secondarily toward conveying information. The traditional classroom format was also consistent with these purposes. The program was not especially suited to overcoming psychological barriers to acceptance of Caltrans' new role, if such existed. At most, Caltrans employees might have been exposed to a variety of points of view, but there was little in the format or design of the program that could have helped them assimilate these or work out their feelings toward them. On the other hand, if all that had been needed was new information, a simpler format--a series of conferences, for instance--might have sufficed. Thus, the appropriateness of the format and curriculum design depended on the extent to which Caltrans' mid-level managers needed to master new skills.

A major defect in the planning of the program was a lack of specific information about Caltrans' day-to-day functioning and how increased responsibilities in the public transportation field might be altering its activities. As a result, the program's planners did not know what new skills, if any, were needed. Since there was no analysis of Caltrans' needs in these areas, it is not possible to say that the program design was inappropriate; however, it is probably significant that the students tended to dislike the analytical portions of the courses and to find them irrelevant. One important lesson to be learned from the certificate-program experience is that planners of similar programs should carefully consider the ways in which changes in organizational missions affect the requirements of specific jobs and should tailor curricula and course content to identifiable needs for new skills. When there are needs other than new skills, program formats other than the traditional classroom should be considered.

A second point concerning curriculum design is that Caltrans' educational needs related to public transportation, whatever they really are, probably differed from district to district. Certainly the districts involved in the program differed in their relationships with planning agencies and transit operators and, to some extent, in their specific duties that involved public transportation. Consequently, there may never have been a need for a common statewide curriculum design. The program would certainly have been cheaper (and might have been more effective) if planning had been decentralized.

If the certificate program's planners were ignorant of Caltrans' specific educational needs, they were equally ignorant of the potential students' backgrounds, interests, and abilities. An underlying assumption in the planning of the program was that students would be willing and able to perform at the advanced-undergraduate or graduate levels of instruction. The planners were greatly surprised by the students' lack of familiarity with basic mathematics and analytical techniques. As a consequence, courses were not taught at the level that had been anticipated, and the certificate program's academic credit was not considered acceptable for regular degree programs. The lessons from this are that planners of similar programs should carefully consider the backgrounds, capabilities, and interests of their prospective students and that they should be extremely cautious in suggesting that off-campus training programs grant academic credit that compares with that of regular degree programs.

Mode of Delivery

The program's delivery was characterized by its decentralization and the involvement of university extension services. The chief effect of the decentralization was to make staffing difficult, since each local program was expected to recruit faculty from a single metropolitan area. In the planning stage, it had been naively supposed that faculty could be recruited from a wide variety of disciplines and specialities; in fact, the course descriptions involved narrow (but sometimes diverse) specialization. Moreover, because it was focused on public transportation, the program involved areas of expertise that were comparatively rare even within the transportation community. Consequently, none of the local programs had an adequate pool of potential faculty to draw from and, in one case (that of Sacramento), faculty had to be imported from outside the local area.

Despite the staffing problems created by decentralization, it is unlikely that a more-centralized program would have been more appropriate. Although the potential faculty pool would have been greater, the cost of bringing the students and faculty together might have been prohibitive. Given the scope of the program (a total of about 15 000 h of student contact), it is difficult to see how it could have been offered on other than a decentralized basis.

The major rationale for involvement of the university extension services in the delivery of the program was that this was essential if potentially transferable academic credit was to be granted. At the outset, it also seemed appropriate to include the university system because of its experience in planning programs of this type and because it was expected that a majority of the program's faculty would be drawn from the CSUC system.

As it turned out, these expectations were largely in error. Academic credit proved to be a relatively unimportant feature of the certificate program. The attempt to provide credit was largely an unrealistic goal.

The lesson to be learned from this is that the involvement of university extension services in training programs sponsored by large transportation agencies should be carefully justified in the planning of such programs. Other modes of delivery, such as organizing the program in house and contracting directly with instructors, may be more effective unless academic credit is appropriate and desirable (an unlikely prospect).

Other questions that relate to the delivery of the certificate program have to do with the details of the program. It is clear that there was room for improvement in several matters of detail. Among these were the lack of standards for the selection of students and faculty, the administrative arrangements that allowed students to be involved in the administration of the program, and the unrealistic schedules (which did not leave time for breaks between classes).

Practicality

Could the certificate program as originally envisioned have been carried out within its actual resource limits? It seems clear that the answer to this question is no. First, the pool of potential faculty was too small to permit the degree of specialization implied by the course descriptions; second, funding for the program was obviously inadequate.

The funding problem stemmed in part from the high cost of the program. This was in spite of the fact that the policies of the consortium and the campus extensions held the actual costs of instruction below what might have been desirable from the standpoint of quality. The main sources of the extraordinarily high costs were the costs of developing the program (all of which were budgeted against the first cycle of instruction) and the costs of statewide coordination. Had the program continued and had its administration been fully centralized, revenues would probably have covered operating costs (even allowing for more-reasonable costs of instruction) and might eventually have repaid the cost of development. Unfortunately, it was never reasonable to assume that the program would continue indefinitely. At most, there might have been enough demand from Caltrans employees to support one or two additional cycles of instruction at two or three locations. Consequently, the decision to assign all development costs to the first cycle of instruction was prudent, but the decision to proceed with the program once the costs were known may have been unwise.

The lesson to be learned from this is that transportation-related educational programs are apt to have high costs, especially if they are highly specialized or innovative. Innovative programs involve high development costs; specialized programs may have low demands and short lives in which to absorb development costs.

SUMMARY

This paper has assessed an innovative educational program that focused on public transportation and was intended for managerial employees of a large state department of transportation. For the most part, this assessment has been critical of the Certificate Program in Transportation. This is not because the program was a total failure but because, by using better planning, it might have been much more effective and perhaps considerably cheaper. The major lessons to be learned from its experience are simple but fundamental to the success of any innovative educational effort of this sort. They are that (a) educational programs should be based on the sponsoring agency's specific organizational needs, (b) the course content and the level of instruction should be based on the interests and capabilities of the students, (c) the mechanism for the delivery of courses should be as simple as possible, (d) specialized programs require specialized faculty and this may be a serious constraint, and (e) innovative educational programs are apt to be expensive; organizations that wish to sponsor them should be willing to pay a premium price.

Discussion

George E. Gray

The authors purport to give an overall assessment of the Certificate Program in Transportation conducted through the joint efforts of Caltrans and the Consortium of CSUC. I found their paper deficient as an overall assessment. In my view, it does not adequately or impartially address the program results (among other things). The degree of program success from the standpoint of the contractee was largely ignored. In addition, I found that the authors presented the findings given in the consortium's required annual program evaluation report (1) in a biased and prejudicial manner.

It is interesting to note that this official evaluation report recommended that the program be run for a second cycle at most of the five sites. It was not recommended for continuation at one small site, primarily because of its size and therefore reduced need for more training of this type. The authors give the impression that, overall, the program was not a success. Such judgments are always subjective, at least to some extent, but in this particular instance I find it difficult to understand why they did not view the program from the perspective of the originators and sponsors before forming this judgment. The only official Caltrans input to the evaluation was through the coordinators. Although four of the five coordinators did recommend that the program be continued, these employees, mainly because of their district orientation, could not be expected to reflect the opinions of the program held by all the originators of the effort.

In this discussion I will focus on what I consider the items of major importance and not dwell on the many comparatively minor items. In their discussion of the latter, the authors stray from the official evaluation findings or from my understanding of the program or both. I will discuss the content and the results of the program.

First, it should be recognized that the program under discussion was one of several interrelated ones undertaken by Caltrans during the period 1973-1978. At that time, Caltrans was providing training to cover new responsibilities through the following programs and opportunities:

1. Certificate Program in Transportation Planning: A centralized program given through the University of California--Davis;
2. Certificate Program in Environmental Planning: A centralized program given through the University of California--Davis;
3. Public Transportation--State of the Art: A one-week lecture and symposium gathering for top-level and mid-level management employees given four times that used a large number of outside experts, both academicians and practitioners;
4. Bay Area Urban Technical Institute: A hands-on one-week course given three times a year since 1977; it is closely coordinated with the five major public transit operators in the San Francisco area and stresses the functions of these organizations and the overall role of the Metropolitan Transportation Commission;

5. Degree program: For several years there has been considerable liberalization of criteria for state participation in external educational programs in transportation; this included a master's degree program of the University of California--Davis given at several locations in the Sacramento area by television;

6. Transportation Planning Improvement Program: This involved loaning employees to various organizations that ranged from local planning agencies to major transit operators and included Bay Area Rapid Transit, Alameda-Contra Costa Transit, Southern California Rapid Transit District, Orange County Transit, port of Oakland, Metropolitan Transportation Commission, Southern California Association of Governments, state of Maryland Department of Transportation, Urban Mass Transportation Administration, and about 15 others; costs were often shared but frequently the state covered all the employee's salary and normal overhead; assignments have generally been for six months but several have been for well over a year;

7. Leaves of absence: Several key employees have been encouraged to accept leaves, which can be as long as two years, to work in related transportation fields; most leaves have been to work with planning agencies but recently transit organizations have also been involved; and

8. Educational opportunities developed and presented by others: There has been strong support for various transportation workshops, seminars, and courses given by the University of California, often developed in cooperation with Caltrans.

In addition to the above specific training programs, Caltrans has an active management transportation reading program and a liberal policy of temporarily loaning employees within the organization to provide on-the-job training. It has organized and presented a number of specific workshops, such as a recent one that focused on commuter rail services, and did have an active information program centered on the department's publication, Transguide, which was updated regularly.

The reason this list of Caltrans' training opportunities is given is to dispel the impression that one receives from the authors that the certificate program was a stand-alone effort. More important, I want to make the point that to provide training in an area of emerging responsibilities for an organization as large as a state department of transportation requires a very diverse program. Admittedly, our efforts have been neither consistent nor particularly well coordinated over a long period of time. There are a number of reasons for this; the major one is government's lack of long-range commitment to such programs, which have results that are difficult to evaluate and therefore to defend through the budget process. In my opinion, no training program that places all of its proverbial eggs in one basket can expect a high degree of success, especially when the incubation period of the training "eggs" is often an unknown since it involves an attitudinal change as much as enlarged or improved technical competence or both.

My most serious single objection to this paper is the lack of evaluation input from the program's sponsor at the top management levels. This input would have provided a more-objective assessment of the value of the results. Overall, the results, especially when reviewed in early 1981, are very gratifying. A large percentage of the state participants have become involved in non-highway-oriented aspects of the department's activities. A quick review of the employees enrolled in the program in San Diego, for instance, shows that those who participated in this educational program tended to show a higher degree of promotion than those who had not participated. They also exhibited a high incidence of movement away from the more-traditional highway roles toward emerging new roles that involved other modes. For the most part, the involvement in transit by Caltrans' San Diego district is being spearheaded by those who were enrolled in this program. Although it can be argued that the total range of the department's transportation activities was probably not greatly enhanced by the program, the department at least had a larger group of employees than had previously existed who had been exposed to transportation in a broader sense.

I will confine the rest of my comments to the three major areas discussed by the authors in the section headed Lessons Learned.

In the subsection on format and content of the program, I found that the points raised were mostly well taken. However, it must be recognized that the state's role in transportation modes other than the highway mode is still evolving and that to expect an organization to be able to identify its future needs succinctly in new areas when it is undergoing such a massive change in responsibilities is naive--it is simply not possible when legislative actions each year result in changes in responsibilities. The intent in developing this program was not to be so specific when formulating course content as to lock the program in to what might become redundant topics. In my opinion, our main failing in this area was in placing too much emphasis on technical skills to the detriment of addressing the various points of view in the public transit field.

It is interesting to note that in this section the authors argue for more program flexibility. This is not consistent with the earlier discussion but it is in line with the program originator's intent.

The problems caused by differing student backgrounds are certainly real and should have been considered more seriously. However, since the program accepted employees with diverse backgrounds (engineers, planners, right-of-way agents, etc.), even a detailed identification might not have changed the results. The choice was between a program designed for a specific group (i.e., planners) or a broader approach. We consciously chose the latter.

With regard to the subsection on mode of delivery, as previously discussed, Caltrans has developed in-house programs of this type before and in-house development is an alternative that has some attractive features. However, that alternative was not pursued in this case for three reasons:

1. We wanted to attempt an innovative consortium concept since, among other things, it provided an opportunity for participation by persons other than Caltrans employees.

2. The department did not have the staff time to organize an in-house program of such magnitude in five locations in a short time.

3. We wanted to provide an opportunity to obtain academic credit for at least a portion of the program.

Although the authors discount this last factor as of no interest or importance to students, the following data, taken from the formal evaluation report (1), give a different picture:

Campus	Percentage Who Had Master's Degree	Percentage Who Thought Academic Credit Important
San Diego	7.1	38.5

Campus	Percentage Who Had Master's Degree	Percentage Who Thought Academic Credit Important
Los Angeles	26.7	50.0
San Bernardino	20.0	20.0
San Francisco	31.2	43.7
Sacramento	8.3	66.7

As for the practicality of the program, the failure to estimate program costs must be shared by all parties involved, and the lesson as given in the last paragraph of this subsection is, in my opinion, valid. Caltrans is currently developing a similar program, Certificate Program in Rail Transportation, and we will now have a better base for estimating program development.

To sum up, in my opinion, the authors are not consistent with the facts in several instances and do not adequately address the certificate program from what may be the most important perspective--that of the organization that originated the innovation. I urge any who have a strong interest in this particular program to obtain a copy of the official evaluation report for study before they arrive at any conclusions.

Authors' Closure

There are several reasons why we did not assess the program from the point of view of its originators and sponsors (i.e., Caltrans' top-level management personnel). First, the program was officially sponsored by the consortium (not by Caltrans) and the Caltrans representatives were by no means the only source of advice in its design. We do not feel that their point of view should be the only one considered, and it should not necessarily be the major one. Second, the study design for the consortium report was negotiated among consortium and Caltrans representatives and one of us. The reason that Caltrans personnel other than the district coordinators (and, of course, the students) were not interviewed was that the Caltrans representatives did not suggest that they should be. Third, we believe that actions speak louder than words. Caltrans (presumably its top-level management personnel) refused to fund the second cycle despite the positive recommendation of the consortium's evaluation report. Further, it is important to note that the recommendation to fund a second cycle was made primarily on the advice of the majority of the Caltrans district coordinators. If the program was successful and there was further student demand, why was it not repeated? We feel that Gray could have done us (and the readers) a greater service by explaining the reasoning behind the decision not to fund the second cycle instead of offering us his personal opinion that the program was successful.

We are of course gratified that Gray was pleased with the results of the program. We feel that the benefits he cites are rather vague, but then it may be that, as a sponsor and originator, his goals were vague. Indeed, one of the main points in our critique of the planning of the program is that goals were quite nebulous and conflicting. Under these circumstances (as we pointed out), it is difficult to judge whether the program was successful or not, since we (Banks as a member of the academic program committee and Rea as the evaluator for the consortium) were never sure exactly what the program was supposed to achieve. In any event, to say that a particular individual was or was not pleased by the results still begs the following questions: (a) Was this the best way to achieve the desired results? (b) Were the results worth the cost?

In addressing the specific lessons to be learned from the program, Gray seems to be in substantial agreement with us. One major difference, however, is whether academic credit was an appropriate and realistic goal. Our position on this issue is as follows. In order to be meaningful, academic credit must represent a definite and appropriate level of student achievement. Although it is difficult to define this level of achievement without reference to specific course objectives and methods of measuring academic achievement, those of us who teach regularly have a good sense of what this achievement entails and whether it is being attained. Accordingly, if we believe that a particular program is maintaining an adequate academic standard, we will be willing to accept its credit toward a university degree; otherwise, we will not.

In the case of the Certificate Program in Transportation, it was assumed at the outset that graduate-level credit would be granted and that it would be transferable, at least within the CSUC system. As the program progressed, it became clear that the level of instruction was falling well below what is normally expected of graduate courses and that the credit granted by the consortium would not be accepted by the CSUC campuses. One reason for this is that less control over student backgrounds (particularly educational level) was exercised in the selection of students than had been envisioned in the planning phase. However, we doubt that this was the only reason for the low level of instruction and we further doubt that any program of this sort is likely to meet the usual academic expectations for graduate courses.

In light of this discussion, the question of whether students desired academic credit is really moot. We do not think that the tabular material Gray gives supports the conclusion that students found the academic credit very attractive. (Of course, it is common in regular university programs that all our students seek academic credit.) The key point is that no meaningful academic credit was in fact granted, and we have no evidence that this caused widespread student dissatisfaction except in Sacramento.

In short, the involvement of universities in programs such as the Certificate Program in Transportation is based largely on the desire to grant transferable academic credit. At the same time, however, it is unlikely that these programs can be conducted at a level that will warrant such credit (at least at the graduate level). Consequently, since academic credit is a dubious goal, nonuniversity providers should be considered to give this type of program.

It also appears that there may be some misunderstanding of our comments regarding the specific needs that Caltrans had hoped this program would meet. The point we intended to make was that the mode of instruction adopted for the certificate program was best suited to teaching specific technical skills. We do not imply that it was necessarily realistic for Caltrans to identify such skills. It is our opinion that (a) it is difficult to motivate students to learn skills if they do not think they will have occasion to apply them and (b) if, as Gray believes, less technical content would have been appropriate, then more consideration should have been given to other modes of instruction. We do not think that the traditional classroom is the most appropriate setting for exposure to diverse viewpoints or for achievement of attitudinal changes.

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Role of Outreach Activities in Transportation Education

ROBERT P. SCHMITT, EDWARD A. BEIMBORN, DAVID CYRA, AND ALAN J. HOROWITZ

In order to respond to the educational needs of transportation professionals, transportation operators, and the general public, an outreach program has been established within the University of Wisconsin system. The program, operated by the university's Office of Statewide Transportation Programs (OSTP), brings the expertise of the university to the community to aid in the solution of pressing transportation problems. The program is modeled after the county agricultural extension service, the agents of which form a bridge between the university and the agricultural industry. Two major aspects of the program involve (a) formal short courses, seminars, conferences, and workshops and (b) informal one-to-one assistance. Experience since the establishment of OSTP in 1976 has shown that universities that have a transportation faculty can fulfill an important educational function that is not covered by traditional course offerings and degree programs.

Traditionally, educational programs offered within universities at undergraduate and graduate levels have been aimed at preparing individuals for their chosen careers. These programs follow well-defined curricula and meet professional personnel needs in many fields. Recently, however, there has been an increasing awareness of the need to develop innovative programs that reach practitioners and members of the community directly. Such programs occur outside the classroom and include the concept of continuing education as well as technical and community-assistance programs that involve a broad spectrum of activities.

One means by which such programs can develop is through an approach patterned after the county agricultural extension service, the agents of which provide assistance and advice to farmers in growing their crops and raising livestock. The agricultural extension service involves one-to-one assistance by bringing together technical expertise from a university and persons in agricultural industries who are facing day-to-day problems. This paper will describe how such an effort is developing in the University of Wisconsin system under the auspices of the Office of Statewide Transportation Programs (OSTP) of the University of Wisconsin--Extension.

OSTP is in the Division of Urban Outreach, a unique entity in the University of Wisconsin system because it is part of both the University of Wisconsin--Extension and the University of Wisconsin--Milwaukee. OSTP works closely with faculty and staff from the University of Wisconsin--Milwaukee, chiefly through its Center for Urban Transportation Studies, and with other units of the University of Wisconsin system in order to provide a program in transportation that is widely available to the community.

The program attempts to create an environment in which open communication among participants can occur. The purpose of these efforts is not simply to educate but also to achieve a better understanding of the issues at hand. This in turn leads to decision making that is more effective and more in the public interest. OSTP'S transportation education program consists of two basic components: an educational component carried out through conferences, workshops, and short courses that address topical issues in transportation and a community-assistance component that takes many forms and involves both formal and informal activities.

During its first year of operation, OSTP had a budget of $80 000 and a requirement to generate an income of $8000. OSTP now has a staff of four--a director, a conference coordinator, a community-assistance coordinator, and a secretary. The overall budget is now $110 000 and the income requirement is $27 000. This income requirement is satisfied primarily through registration fees charged to conference attendees. In this paper, the activities of OSTP and the overall philosophy of the program will be discussed.

PHILOSOPHY OF THE PROGRAM

OSTP was established in September 1976 by the Division of Urban Outreach of the University of Wisconsin--Milwaukee and the University of Wisconsin--Extension to respond to increased educational needs in transportation within the Milwaukee metropolitan area and the state of Wisconsin. The philosophy of OSTP is based on the premise that the resources of the university can be applied to community needs in transportation in a variety of ways. This philosophy recognizes the importance of community input; without it, many needs would not be addressed.

The philosophy of the outreach program consists of the following six basic principles and beliefs:

1. There is a fundamental relationship between the university and the community of which it is a part. Communities benefit from increased educational opportunities and from the application of knowledge obtained through the university. The university benefits because its faculty and staff gain practical experience that is reflected in future outreach activities and traditional educational offerings. Thus the community represents a dynamic laboratory that provides important input to the educational function through, for example, timely case studies from local settings. As a consequence, students who take part in this process are exposed to real-world transportation-related issues within the community.
2. Transfer of information, research, and education can best occur when there is close communication between those who are faced with problems and those who have the capability to lend assistance in solving them. The closer the university can be linked to the community, the higher the probability is that the education and research done at the university will be relevant and useful to the community. Close communication between university and

community throughout the educational and research process is required to maintain a capability of providing effective and efficient programs.

3. Historically, the university has been viewed as a leader in education and in the creation of new knowledge. If the university is to remain at the cutting edge of relevant applied studies and thus meet the demands of a complex society, it must reach out into the community and play an active role in defining problems, in providing objective information for policy formulation, and in offering diverse innovative educational activities. This process attempts to respond to community needs as they arise as well as to anticipate needs before they arise.

4. Transportation outreach programs must be able to respond to current needs on a real-time basis. That is, the demand for information by practitioners and others is often immediate; situations occur in which the practitioner requires specialized knowledge quickly. Because the areas of interest involved are often new, this specialized knowledge is not typically available in journals, books, traditional course offerings, or degree programs within the university. Outreach programs can fill this informational void through quick response and tailor-made programs that directly meet the needs of practitioners.

5. As is well known, some of the issues that arise in transportation are highly controversial, and dialogue between opposing forces may be confined to formal processes such as public hearings. In such cases, resolution of an impasse can be facilitated if opposing groups have a better understanding of each other's position and the reasons for those positions. In these situations the university, unlike participating agencies, can provide a neutral environment within which effective focused dialogue can take place.

6. The lifeblood of a transportation outreach program involves recognition of the community as the most important resource. Problem definition, issue identification, and program planning and development are necessary in order to enhance the benefits of the outreach program.

The philosophy of outreach program development, whether conference planning or assistance, demands a collaborative approach, that is, an approach in which there is a genuine interchange between program planners and community representatives throughout the entire program-planning process. The approach entails far more than attempting to sell a prepared program or seeking the blessing of key people. OSTP can be compared to a counselor whose job is to assist the community in discovering and achieving its objectives.

GOALS AND CRITERIA

In keeping with this philosophy, the following goals of the outreach programs in transportation have been developed. These have been formulated with the intent of making optimal use of university and community resources while providing clients with products that are useful. The goals are as follows:

1. To focus the considerable talent of the university institutions on transportation problems and to make this expertise available to agencies and groups within the region,
2. To offer technically sound professional-quality applied research and educational programming that responds to demonstrated transportation needs,
3. To identify transportation-assistance needs throughout the areas served by the university, and
4. To provide both professionals and citizens with up-to-date information on important topics such as transit, goods movement, and transportation energy conservation through applied research, educational programs, and direct-assistance activities.

In order to carry out these goals, criteria have been established for the development and selection of individual projects. These criteria ensure that the programs offered by the university relate directly to user needs and that they are offered in a constructive and responsible manner. The criteria for project selection are as follows:

1. Can the project results be transferred to other areas of the community and the state?
2. Does the project lead to improvement of knowledge and to more expertise in the local area?
3. Does the project lead to specific improvements within the community?
4. Does the project deal with an area of critical need?
5. Would the agency or group that has the need have much likelihood of otherwise obtaining the resources to deal with the problem?
6. Does the project lead to improved expertise of university faculty?
7. Is there a clear understanding of who the potential users are and have they been given the opportunity to contribute to the problem-definition phase of the project?

Although few potential projects rank high on all criteria, projects that are seriously deficient in one or more areas have little chance of being undertaken.

PROGRAM COMPONENTS

The primary objective of OSTP is to reach out and to serve the community through expanded transportation education. The overall outreach program designed to satisfy this objective has two components--a formal conference component and a community-assistance component.

Conference Component

Within the conference component, OSTP plans, develops, and administers noncredit courses, institutes, and workshops in transportation. These educational activities typically address one issue-oriented topic. The programs bring together the latest knowledge on emerging issues, and participants are encouraged to propose solutions. Participants come from Wisconsin and throughout the United States and include professionals from a wide range of disciplines, concerned citizens, and university students. Examples of conferences and short courses offered from 1978 to 1980 are shown below:

Coordination of Urban Transit Services, Oct. 16-17, 1980, Milwaukee
Essentials in a Specialized Transit Driver Program, Oct. 6-8, 1980, Madison
Practical Considerations in Rural Transit, Aug. 18-20, 1980, Stevens Point
Quick Response Methods for Urban Transportation Decision Making, July 28-30, 1980, Milwaukee
Midwest Rail III: Restructuring for the 1980s, June 16-17, 1980, Madison
Risk Management and Insurance Issues Facing New Transportation Programs (Problems and Solutions), May 12-13, 1980, Milwaukee
Seminar on Traffic Engineering in Small Communities, April 24, 1980, Beaver Dam

External Transportation in Milwaukee's Future, Nov. 2, 1979, Milwaukee
Freight Movement In and Through Urban Areas, Oct. 8-9, 1979, Milwaukee
Recent Developments in Rural Transit, Aug. 6-8, 1979, Stevens Point
Midwest Rail II: Light Density Lines, June 25-26, 1979, Madison
Basic Rail Planning, Nov. 16-17, 1978, Milwaukee
Coordination of Urban Transit Services, Sept. 14-15, 1978, Milwaukee
Operation of Rural Transit Systems, Aug. 10-11, 1978, Stevens Point
Midwestern Rail: Problems and Alternatives, June 26-27, 1978, Madison
Transit Personnel Relations, May 18-19, 1978, Milwaukee
Community Participation in the Transportation Planning Process, April 13-14, 1978, Milwaukee

OSTP maintains an internal planning committee that consists of university faculty and staff. Each member of this committee has an area of transportation specialization. The function of this committee is twofold. First, since members are in touch with recent transportation developments in the community and elsewhere, they suggest possible topics for conferences and short courses. Second, the committee identifies resource persons who may be helpful in planning or participating in a future conference.

A conference may involve active participation of practitioners and officials from the community and elsewhere. In the past, OSTP has had transportation coordinators of local agencies serve on panel discussions; staff members of the Wisconsin Department of Transportation speak on state transportation legislation and plans; federal agency personnel speak on federal regulations and legislative initiatives; railroad management, labor, and shippers speak on problems that face the railroad industry; and representatives of taxi companies and school-bus associations address the potential role of private transportation service for special groups. Major conferences have been held in Milwaukee, Madison, and Stevens Point. In addition, university faculty have recently offered a series of 3-h seminars on rail planning and on transportation for the elderly and disabled throughout the state.

In summary, the conference component of the outreach program takes an interdisciplinary approach and is designed to ensure that public decisions will reflect the values, needs, and priorities of those affected by such decisions. In this case the university, as neutral ground, conducts a program that involves diversified opinion and current facts that can lead to resolution of critical problems.

Community Assistance

The second program component is transportation assistance to communities and agencies in which the university provides a vital link between a transportation need and the educational and research resources that can satisfy that need. In the spirit of outreach, OSTP provides the assistance for self-help in definition of the community problem and in preparation of alternative courses of action. For a governmental agency, this program component leads to increased utilization of available transportation expertise in resolving problems. In the spirit of cooperation, this relationship among the university, the community, and the governmental agency promotes high-quality, more-useful transportation service.

Community assistance means working with individuals from various agencies to help identify and solve transportation problems. Ideally, this is an ongoing process by which problems are either addressed as they arise or anticipated in advance. An appropriate strategy is then worked out between university and agency personnel.

The community-assistance component may take one of two general forms. The first form is assistance to a single agency through one-to-one consultations, periodic seminars, program evaluation, research, or preparation of educational materials such as slide programs and training manuals. The second form of direct assistance consists of seminars or meetings that are organized locally by using a maximum amount of community input. Persons or agencies can thereby seek solutions to transportation problems through interaction with others in similar circumstances. The involvement of the university enhances cooperation and provides a legitimacy to the complete process.

Case Studies

In this section, four case studies are examined. They have been selected to demonstrate how the two basic components of transportation outreach programs function.

Traffic Engineering: New Richmond, Wisconsin (1976-1978)

New Richmond, a rural city of approximately 4200, was experiencing several problems regarding traffic flow. In December 1976, the mayor asked OSTP to assist in alleviating some of these traffic problems. Working with a University of Wisconsin--Extension community resource development agent, city representatives, and representatives of other public agencies in the area, OSTP established two committees. One was a seven-member citizen transportation committee and the other was a companion technical advisory committee.

The technical advisory committee consisted of seven members that included representatives from the Wisconsin Department of Transportation, West Central Wisconsin Regional Planning Commission, the County Planning Office, and the University of Wisconsin--Extension. The committees were the catalyst for actions taken by the city to improve traffic circulation.

The New Richmond experience provided guidelines for establishing transportation outreach programs in small rural communities:

1. Even though there is a public agency in a rural area that has the responsibility for transportation planning assistance, the assistance may not flow until some social interaction between agency personnel and the community establishes rapport and the agency becomes familiar with community problems.
2. When transportation committees are formed in rural towns or counties, the committees must be sanctioned by public governing bodies. Otherwise, much planning can be done but there will be little or no implementation.
3. Transportation affects a wide range of economic and social activities. Consequently, committees that are established to deal with transportation problems should have representation from many sources. Broad-based input and support further improve the chances that plans will be carried out.

Since the New Richmond experience, OSTP and University of Wisconsin--Extension community resource development agents have provided assistance to three other rural communities in Wisconsin.

Railroad Planning Conferences (1976-1980)

OSTP established a continuing-education workshop entitled Basic Rail Planning. It has been offered once every year for the last four years. These workshops have trained Wisconsin residents and residents of 31 other states. A total of 162 persons have attended these workshops; those who found themselves in a rail-planning role and were not familiar with the jargon, law, and procedures of rail planning benefited the most.

OSTP also sponsored an informational series entitled Midwest Rail. All these conferences are taped, and complementary tapes are furnished to the Federal Railroad Administration, Wisconsin Department of Transportation, and the library of the University of Wisconsin--Extension. During the last three years, 246 residents of Wisconsin and residents of 25 other states have attended these conferences. Some of the lessons learned from sponsoring rail programs include the following:

1. Federal and state rail transportation agencies appreciate rail programs, especially when they have the opportunity to develop conference structure, select speakers, and send their own personnel to be trained.
2. Because the railroad industry is changing dramatically, periodic educational sessions are essential for maintaining pace in the field.
3. Programs can be an effective means of helping individuals deal with immediate problems. For example, about four years ago railroad abandonments were vigorously fought, especially by community resource development agents. Evaluation procedures derived from training and information update sessions provided procedures for judging abandonments in a more-equitable manner.

Human-Service Transportation (1976-1980)

An important benefit of collaboration when conferences are sponsored or assistance is provided is that, when information flows freely, learning occurs for all persons involved. For instance, the information learned from sponsoring 10 conferences and workshops on human-service transportation enabled OSTP to provide one-to-one assistance in the areas of plan coordination, equipment selection, operations, monitoring, evaluation, and record keeping.

An outreach function in a university is also a valuable resource for state agencies. Generally, state agencies do not participate in formal public education. During the period between April and November 1978, OSTP conducted five one-day workshops throughout the state in a joint effort with the Wisconsin Departments of Health and Social Services and of Transportation. These workshops, entitled Specialized Transportation, Our Common Denominator, were used to introduce the concept of coordination and to explain preliminary guidelines that were developed for administration of the program under Section 18 of the Urban Mass Transportation Act of 1964, as amended.

In addition to the benefit of learning in a collaborative process, an intrinsic development of trust and confidence is also built when efforts are sincere and meaningful. These educational programs for human-service transportation provided further direction for outreach efforts:

1. Although the level of sophistication among transportation administrators has greatly increased during the last four years, continuing assistance is necessary because of new personnel, new programs, changes in laws and regulations, and the need for coordination.
2. Transportation service is finally becoming recognized as a large expenditure in agency budgets. Giving it the attention it deserves requires a higher level of expertise in operations and administration and thus a greater emphasis on continuing education.

Milwaukee County Institutions Grounds (1979-1980)

An example of interaction between outreach programs and traditional university education is provided by recent assistance to the Milwaukee County Institutions Grounds (MCIG). MCIG is the location of major public medical facilities for the Milwaukee metropolitan area. Despite its suburban location, MCIG experienced severe shortages of parking for its 16 000 employees, patients, and visitors. OSTP was asked to investigate ways to reduce demand for the limited parking facilities. It was apparent that considerable background information would need to be developed, so the Center for Urban Transportation Studies (CUTS) of the University of Wisconsin--Milwaukee was asked to participate. Three graduate students at CUTS, sponsored by OSTP, conducted a classical transportation planning study that included a travel survey of all MCIG employees.

MCIG staff gained confidence in the students' work and suggested that a follow-up study look at the transportation problems of patients and visitors. This second MCIG study was adopted as a class project for a graduate course in transportation planning. MCIG staff worked closely with the students in broadening the earlier study. A spin-off of the second MCIG study was a research paper that documented an innovative technique for measuring the physical accessibility of medical care to transit-dependent groups of patients. Results of the MCIG experience include the following:

1. Graduate students can be effective in outreach activities, particularly if they are given guidance from faculty and sufficient time to explore important issues.
2. Participation in outreach activities provides a learning experience that is a valuable supplement to traditional university offerings.
3. Transportation problems observed during outreach efforts can provide direction to applied research for university faculty.

CONCLUSION

Since the inception of OSTP, considerable experience has been gained in outreach activities related to transportation. Through this process several general lessons have been learned. They are presented here so that others may benefit from this practical experience:

1. Transportation outreach is an important activity for a university. There is a need for the university to act as a neutral party to bring people together to discuss crucial issues that affect the community.
2. Community input to program planning is a continuous process that is often difficult to formalize. Although committee structure has been used, most input is derived through intermittent contact with key individuals at the local level.
3. Community outreach allows locally based agencies to acquire technical assistance that they would otherwise have to do without, since restricted budgets preclude the use of professional consultants.
4. Outreach programs enhance the curriculum

within the university. Courses in transportation can often benefit from the use of case studies obtained from community-assistance activities, and students in these courses are encouraged to attend formal conferences.

5. Involvement in an outreach program enables faculty to keep up with current activities in a topical area of transportation as well as with community problems and issues.

6. It is important to remain open-minded and flexible when programs are planned, developed, and implemented. This is particularly true with respect to community assistance. One should recognize that community assistance is most effective when it is viewed as a learning experience for all parties involved. The attitude that "we're here to solve your problems" is rarely effective.

7. Finally, it has been learned that transportation outreach programs can be highly beneficial to both the community and the university. The community can benefit from greater access to professional expertise to assist in solving their problems. The university can benefit through a better understanding of problems faced in the world outside the university, which enables them to aim their activities in a more-relevant direction.

Transportation Engineering and the University: Past, Present, and Future Challenges

ROGER P. ROESS AND LOUIS J. PIGNATARO

Some of the major challenges faced by universities in developing transportation programs are discussed and the history of one program's response to these challenges is traced. Current challenges, such as the increasing number of foreign students in transportation programs, the shifting emphasis in management aspects, and the inclusion of women in technical programs, are also discussed as well as problems that are now waiting on the horizon, such as declining graduate enrollments.

In 1956, the federal government authorized the largest single public works project in the history of mankind--the construction of the 41 000-mile national system of Interstate and defense highways. With it was introduced a variety of federal road-user taxes to be placed in the Highway Trust Fund, created to finance part of the cost of the system; the federal government was to provide 90 percent of the total cost.

The system had been comtemplated since the mid-1940s and strongly supported by the trucking industry, but it took more than a decade to become a reality, primarily due to two major issues: (a) how to pay for the system and (b) whether the system should be built into urban areas or around them as bypass or circumferential highways. The latter proved to be the thornier issue, which was eventually resolved in favor of building into cities, a decision that had drastic impacts on suburban development and, in some cases, urban deterioration.

The impact of the 1956 action was to take federal highway disbursements, which had totaled about $7 billion in the 35 years between 1921 and 1956, and immediately increase them to $4 billion per year and later to more than $6 billion per year.

In 1962, the federal government introduced the requirement for ongoing comprehensive transportation planning for all urbanized areas (cities that had a population of 50 000 or more), thus giving rise to myriad metropolitan planning organizations (MPOs) and to the institutionalization of regional transportation planning. In 1964, the first Urban Mass Transportation Assistance Act was the federal government's formal recognition that highways were not the only mode of transportation and this provided the impetus for renewed interest in public transportation planning and development.

By 1968, some of the disbenefits of massive highway construction were now evident, and some legal brakes were applied, for example, the capping of the Interstate system at 42 500 miles and the requirement that two public hearings be held before a project was undertaken. Federal funding for arterial and street improvements through the Traffic Operations Program for Increasing Capacity and Safety (TOPICS) also began. In 1970, the Environmental Protection Act further retarded highway construction in urban areas and required the explicit consideration of environmental impacts in the planning and design process.

This brief history is merely background. In the 14 years between 1956 and 1970, the professional discipline of transportation planning and engineering was born and developed into the specialty now practiced. That is not to say that the decade of the 1970s did not also greatly influence the profession but to recognize that, before the 1970s, there was no generally recognized discipline and, most important, there were few systematic approaches to the emerging field in the universities.

INITIAL CHALLENGE

Highway engineering (i.e., highway construction and physical design) has long been an integral part of most civil engineering programs. Such courses have existed at the Polytechnic Institute of New York since the early 1940s. By the early to middle 1950s, programs that had a strong highway curriculum began to introduce traffic engineering (i.e., functional design and traffic control) as a distinct subject specialty. By the early 1960s, several universities (including Polytechnic) had established strong programs in the two key areas of highway and traffic engineering.

Comprehensive regional transportation planning entered the scene in the late 1950s by means of the Chicago Area Transportation Study (CATS), which became the model for many such studies. Such planning became critical in 1962 when the federal government mandated ongoing comprehensive transportation planning.

The university faced a number of major problems

in responding to the need for professionals who had specialized training in these new areas:

1. Adjustment of highway-oriented curricula to reflect multimodal transportation systems concerns;
2. Adjustment of engineering curricula to reflect the emerging emphasis on transportation planning;
3. Accommodation in this new area of undergraduates who had multidisciplinary backgrounds, many of whom were not engineering students (given that programs were traditionally housed in engineering departments); and
4. Formation for an emerging, rapidly changing field of curricula that both kept up with the latest developments (and indeed helped to forge the state of the art) and retained a sufficient core of basic principles and methodological approaches.

Of these problems, the interdisciplinary nature of the transportation field created a most difficult problem. First, the historical association of transportation curricula with civil engineering programs made acceptance of nonengineers procedurally difficult. Second, the interdisciplinary nature of transportation dictated that most of the initial programs be at the graduate level.

Further, the massive undertaking involved in the creation of totally new curricula--which involves new courses, new approaches, and new types of laboratories and workshops--is difficult to address without some form of external or institutional support. A brief recitation of how Polytechnic faced these challenges illustrates the point.

As has been previously noted, Polytechnic had offered highway and traffic engineering courses as part of its civil engineering program since the 1940s. In 1965, the Division of Transportation Planning was formed within the civil engineering department and, more important, a separate designated M.S. degree in transportation planning was initiated. The development of the division and the new degree program was greatly enhanced by a grant from the New York State Science and Technology Foundation. The formation of the division had several advantages in addition to the offering of one of the first such degrees in the nation:

1. The division could establish its own admission requirements, including the admission of nonengineering undergraduates;
2. The division was granted an operating budget separate from that of the rest of the civil engineering department; and
3. A director was appointed for the division, which provided clear-cut programmatic direction.

However, by 1969, the division still had only two full-time faculty members and two faculty members from other programs who devoted about one-third of their time to transportation education. From 1966 to 1969, the division achieved a number of valuable contracts, which aided its growth. In 1969, the division was awarded a university research and training grant from the U.S. Department of Housing and Urban Development [later the Section 11 program of the Urban Mass Transportation Administration (UMTA)]. Polytechnic has been funded continuously under this program since that time, which has provided the continuity needed to build a major program. This support provided two key opportunities: (a) ability to fund full-time fellows, which changed the character of the program from one in which 95 percent of the enrollment was part-time evening students to one in which a substantial full-time student body existed, and (b) ability to add full-time faculty to the program. As full-time faculty were added, more research proposals were written, more funding was achieved, more fellows were supported, and additional faculty were added--a ripple effect. By 1975, the program had stabilized and had eight full-time faculty members devoted entirely to transportation, one of the largest such faculties in the country.

In 1970, in recognition of the program's steady growth, the division was granted full department status and remains today the only academic department for transportation studies in the United States. In 1975, the cost of the program's research activities was more than $750 000 a year, and the Transportation Training and Research Center was formed to provide more-efficient administration of interdisciplinary research.

The research support of UMTA and other agencies also provided the ability to develop new courses and curricula in planning, public transit multimodal systems, and other areas. The program requirements in 1965 and in 1980 for a master's degree in transportation are compared below:

Course	Credits
1965:	
Elements of Probability	2
Elements of Mathematical Statistics	2
Introduction to Urban Planning	2
Highway Economics and Planning	2
Design of Traffic Facilities	2
Traffic Engineering I	2
Traffic Engineering II	3
Urban Transportation Planning	3
Traffic Workshop	2
Projects and electives	10
	30
1980:	
Applied Statistics (program prerequisite)	0
Transportation Studies and Characteristics	3
Travel-Demand Forecasting	3
Transportation and Traffic Workshop	3
Urban Planning Principles	3
Traffic Control, Operations, and Management	3
Transportation Economics	3
Projects and electives	18
	36

The program emphasis has shifted sharply from highway and traffic to multimodal planning and functional design. Further, in 1965, only 6 elective courses in transportation were available compared with 27 today in such special areas as highway and traffic engineering, urban planning, transportation planning, public transportation planning and operations, transportation safety, and transportation economics and management.

The department structure, unique to Polytechnic, has afforded a degree of visibility, independence, and ability to recruit an interdisciplinary faculty in a single academic department that is generally not available in other forms of organization such as interdepartmental programs and the traditional civil engineering approach. It was only after substantial external funding was achieved, however, that the administration of Polytechnic agreed to such an arrangement.

THREE KEY CHALLENGES FOR THE 1980s

The previous segment of this paper treated the historical challenges that Polytechnic and many other institutions have faced and overcome during the formative years of the transportation profession. This section deals with three key areas in which the Polytechnic program currently faces challenges and briefly outlines the approach being

pursued in each case. Again, these are problems that are common to many transportation programs across the United States.

Influx of Foreign Students

By 1975, almost one-third of the students enrolled in Polytechnic's transportation program were from outside the United States; more than 90 percent of these came from the developing nations. By 1980, this percentage had increased to about one-half the total student body and more than three-fourths of the full-time student population.

This has presented a number of administrative difficulties, which include the evaluation of foreign transcripts, communication problems, etc. The most difficult problem, however, is the curriculum: Developing nations view transportation as a critical tool for economic development. As such, their approach to planning considers goals and objectives that are far different from those usually used in the United States, in which all transportation improvements are incremental rather than basic. Other differences also exist. The technology of transportation used in most developing nations differs substantially from our own. For example, the manual construction of earth or simple penetration roadway surfaces still predominates in many areas. The movement of goods and materials rather than the movement of people is often of paramount importance. Further, unlike the United States, in which the most challenging transportation problems exist in the urban areas, many developing nations must still solve serious intercity transportation problems, including the development of ports. In light of this, it must be noted that a portion of the standard transportation curriculum is irrelevant to a student from a developing nation. The challenge is to provide more-useful and more-relevant professional training for such students.

After extensive surveys of such students and discussions with noted consultants who are working in developing nations, a number of key areas of need have been isolated:

1. Decision making: In the United States, the decision to implement a particular transportation improvement and the selection of the particular plan or design to implement are based on a variety of complex incremental analyses of direct impacts such travel time and mobility and environmental effects and on secondary impacts such as the effect of the improvement on a local or regional economy. This is proper, because a single improvement in a dense transportation environment would not have a marked effect on the overall economy (although there are clearly some specific examples that would). In the developing economy, these secondary impacts are the primary consideration, and incremental considerations such as travel time, travel costs, etc. are of minor interest. This changes the entire nature of the decision-making process, including the proper implementation of benefit/cost and cost-effectiveness analyses of proposed transportation projects.

2. Financing: The financing of capital and operating costs of transportation systems in the United States is accomplished through a complex but well-defined combination of private and public monies. Public funding on a massive scale occurs through established federal, state, and local governments that use a variety of tax measures to pay these expenses. In the developing economy, bureaucracy for financing the huge expenses of massive transportation systems is not as well defined. Further, the ability to tax is often hindered by the general state of the economy. Although funding from within is often difficult in a developing economy, there are a variety of international sources of funds that can be tapped in several ways. The international student must have these sources better highlighted rather than have detailed analyses of the structure of the U.S. system.

3. Construction techniques: In developing nations, many rural roads are still being constructed as compacted-earth or penetration surfaces. The foreign student needs instruction in the construction of such roads, which are no longer built and are considered substandard in the United States. Further, construction in developing countries is often accomplished by using labor-intensive manual techniques rather than the highly mechanized procedures used in this country.

4. Management: The foreign student often returns to his or her home country in a supervisory capacity and often finds himself or herself in the position of managing complex construction projects. Construction will often involve foreign (U.S. or other) consultants and a variety of local companies. Managing such multinational efforts presents special management problems with which foreign students should be prepared to deal.

Because of these special problems concerning foreign students, the department found it necessary to decide to either develop a curriculum geared to their needs or discourage their entry into the program. The department chose the former course in the belief that a substantial portion of the demand for programs in transportation will continue to be from developing nations and that the educational need for specialized training in this area is acute.

A special program for a master's degree in transportation planning and engineering for students of developing nations was introduced in 1978. Its requirements, which reflect the above concerns and extend substantially beyond the standard master's degree program, are listed below:

Course	Credits
Transportation Studies and Characteristics	3
Travel-Demand Forecasting	3
Urban Planning Principles	3
Traffic Capacity and Design	3
Economic Analysis of Transportation Projects in Developing Countries	3
Case Studies in Regional and Transportation Development	3
Managerial Accounting	3
Projects and electives	33
	54

Electives specially developed for this program include the following areas (3 credits are given for each course): financing transportation projects, design and construction of roads, construction of transportation projects, and energy alternatives. It had been hoped that contractual agreements with foreign governments and universities would support the program, but this has generally not occurred. Agreements with two foreign universities--National Chiao Tung University in Taiwan and Yarmouk University in Jordan--have caused several doctoral students to enter this degree program, but broader arrangements have not yet been achieved.

Although individual courses in this program have been greeted with enthusiastic interest, the program as a whole has been less successful than had been anticipated for several reasons:

1. Individual foreign students are reluctant to take the additional credits required for the program,
2. Support for extensive marketing (including

foreign travel) to achieve contractual arrangements with foreign governments has not been available, and

3. A major source of foreign students (Iran) has been disrupted.

While the contractual arrangements that would make the overall program a success are still being pursued actively, program material has been made available to foreign students through special seminars, offerings of selected topics, and individual guided studies. Some material has also been incorporated into the courses for the standard master's degree program.

Emphasis on Management Aspects

Over the past several years, transit operators and transportation agencies have expressed the need for students who are more highly trained in the economic and management aspects of the transportation profession and who also have a basic understanding of planning and engineering. In fact, approximately 30 percent of the program's graduates are employed in managerial positions, even though they lack specific training in management and transportation economics. Further, as the number of nonengineers who enter the transportation field increases, it is clear that a less technically oriented program might serve their needs better.

Polytechnic approached this subject cautiously. First, a series of elective courses was developed based on economic and management issues. These courses were placed into the regular master's degree program as a minor. In 1976, a joint degree program was initiated with the Department of Management, which resulted in the awarding of a dual M.S. degree, one in transportation planning and engineering and one in management. The total number of credits required for the dual degree (although 9 units were double-counted) was a severe drawback.

In 1979, a single program in transportation management was introduced at the master's degree level. It consisted of a core that included basic management skills, basic transportation operations skills, the initial series of transportation economics and management courses, and additional courses specific to the program, such as analysis of transportation markets, legal and regulatory aspects, behavioral and societal aspects, and intercity passenger and freight transportation. To bolster registration in the new courses, they were also made available to students in either the transportation or the management programs as electives.

The program has been quite successful to date and had five full-time students and five part-time students during its first year of operation. The first degrees from the program were awarded in June 1980, and total enrollment for fall 1980 appears to be about 15, a rewarding figure for the program's second year of operation.

Role of Women in Technical Professions

In response to governmental requirements for affirmative action, both schools and employers have been making an extensive effort to involve women in technical fields. At the graduate level, this has been and continues to be a difficult problem, since the number of women undergraduates in technical areas is not high (although it has been increasing in recent years). Transportation programs, because of their interdisciplinary character, are an ideal means by which women who do not have technical backgrounds can enter a technical field.

At Polytechnic, the percentage of women in the transportation program has varied between 5 and 15 percent and has generally been considerably higher than in the other graduate programs. However, to increase the involvement of women in transportation, Polytechnic, through its Transportation Training and Research Center, recently applied for and received one of six new Women in Science grants from the National Science Foundation.

The grant is aimed at the retraining or reorientation of college-educated women who are underemployed or who have been out of the job market for several years. The grant will provide a tuition-free program that consists of (a) special short courses and seminars and (b) a selection of regular graduate courses. The program will accommodate as many as 40 women, each of whom will receive a graduate certificate and earn 15 units toward a master's degree. The program will be given over a three-semester period that begins in spring 1981 on a part-time basis. The part-time basis is important, since it will allow women currently working to continue to do so while studying. The three-semester program plan is outlined below:

1. First semester
   a. Special seminars: Careers in Transportation (two days), Planning (two days), Applied Statistics (eight weeks for 4 h/week), and Analytic Concepts and Techniques (four weeks for 4 h/week)
   b. Regular courses: Transportation Studies and Characteristics (3 units)
2. Second and third semesters
   a. Special seminars: Technical Writing (20 h), Public Speaking (10 h), Working in Design Teams (10 h), and Job Resume and Interview Techniques (one day)
   b. Regular courses: 6 units per semester in selected areas such as planning, public transportation, traffic engineering, transportation economics, and management

It is hoped that many of the women trained in this program will be placed in entry-level positions in the profession. Special job-placement services will be made available to the participants. It is also expected that many of the women in this program will continue their studies toward a master's degree, as has been the case in similar programs in other disciplines at Polytechnic.

BUILDING A CURRICULUM

In the 15 years between 1965 and 1980, Polytechnic established a new academic department, three new degree programs, a research center, and more than 30 new courses in the field of transportation. The building of such a curriculum is a gradual process, which was aided by two key operating principles:

1. Research funding should be used in a way that permits the support of full-time students and provides material for the development of new and/or revised course curricula, and
2. When new programs or courses are introduced, it is wise not to rely on a totally new student market; making courses available as electives to students in other programs allows a new program to develop a student body over a number of years without causing a major economic strain on the university or the department that offers the new program.

In Polytechnic's case, both principles were of great importance. Early support from UMTA permitted the broadening and extension of the curriculum into the all-important area of public transportation and the strengthening of the planning curriculum. Over

the years, the results of funded research projects have contributed to the development of such diverse specialized courses as highway capacity, goods movement, transportation system safety, and numerous others. Today, the program is more or less stable, and curriculum inputs are geared more to refining existing courses than to introducing new ones, but the role of new courses is just as vital. Only in the case of the program for regional and transportation development did Polytechnic attempt to introduce a large number of new courses at one time without making them available as electives to students in other programs. This remains the sole case in which Polytechnic's programmatic and enrollment expectations have not been met.

It is also necessary to maintain an environment in which faculty members are encouraged to assess existing programs and promulgate new academic and research programs, especially those of an interdisciplinary nature, and to devise innovative and imaginative approaches to the educational process.

Academic programs should be evaluated on a regular basis to determine their future direction or workability. The following guidelines should be used as an aid in determining whether to maintain, initiate, or eliminate academic programs:

1. Is the program academically important?
2. Is there now and will there remain significant student interest to warrant its continuance?
3. Is there a high probability that the program will achieve a high level of excellence?
4. Is there a high probability that the program can be adequately and securely financed?

SOME CHALLENGES FOR THE FUTURE

We would be sorely remiss if, in any paper of this type, we did not treat (even in a cursory way) some of the problems and challenges that are beginning to appear and that will have to be faced within the coming decade.

No problem will be greater than the general national trend of declining graduate enrollment in engineering and science programs. Transportation programs could be severely affected by this trend, since most exist primarily on a graduate level. The reasons for the decline are many and complex and cannot be adequately discussed here, but one principal cause over the past several years has been the extremely high salaries offered to undergraduate engineers. Even with fellowship support, it is difficult to attract as full-time graduate students those who are given initial job offers that pay $20 000 per year and more. Whether these students ever rejoin a graduate school on a part-time basis is still not clear, but the impact on graduate transportation programs is that

1. A greater percentage of transportation-program students have nontechnical backgrounds,
2. A greater percentage of transportation-program students are from foreign countries, and
3. Total enrollments in transportation programs have leveled off and are declining.

This is indeed a multiple challenge. Although transportation is an interdisciplinary field, it retains a strong engineering component, and the profession requires many transportation specialists who have engineering backgrounds. The problems associated with increasing percentages of foreign students have already been discussed and relate to their special educational needs. Declining enrollments, of course, stifle growth and limit the number of faculty who can be supported in any given program.

One potential solution, which will require careful consideration over the next few years, is the movement of transportation curricula to the undergraduate level, at least for engineers. This may involve new undergraduate degree programs or minors in existing programs. New degree programs would face the problems of professional accreditation and high school recruiting programs in addition to the many internal university problems associated with starting a new undergraduate program, particularly if it were also to be accompanied by a new academic department.

The increasing percentage of nontechnical students may eventually force the issue of separate curricula and the difficult task of differentiating transportation planning from transportation engineering. Indeed, the whole issue of specialization within the transportation field, including such areas as economics, management, law and regulation, operations, and design, must also be faced. Most programs, including Polytechnic's, attempt to merge parts of many of these specialties to provide a broad professional base of knowledge. Further, enrollments to date would not justify multiple programs. If, however, transportation curricula begin to move to the undergraduate level, then the question of graduate specialization would be a real one and each university would have to carefully select its areas of interest.

Of course, if a clear understanding of the needs of the profession existed, i.e., the number and types of professionals needed over the next 20 years, many of these questions would be more easily answered. Such crystal-ball answers, however, are not available, which leaves the university to face the future with only the advantages of foresight, creativity, and perserverence with which to advance. These have always been sufficient in the past and, we trust, will probably continue to be so in the future.

Training of Transport Specialists

K.W. STUDNICKI-GIZBERT

It is generally recognized that the success of any policy or plan depends on the quality of those who administer it; thus the development of human capital becomes one of the important investments in economic growth, especially in the Third World countries, in which the availability of well-trained personnel is often the main obstacle to economic development. This paper reviews a recent experience in training future transport planners and policy administrators in Argentina. A short description of this program is followed by a discussion of the lessons learned and the training options that other such programs should consider.

It is generally recognized that the success of any policy or plan depends on the quality of those who administer it; thus the development of human capital becomes one of the important investments in economic growth, especially in the Third World countries, in which the availability of well-trained personnel is often the main obstacle to economic development. This paper reviews a recent experiment in training future transport planners and policy administrators in Argentina. A short description of this program will be followed by a discussion of the lessons learned and training options that other such programs should consider.

The shortage of transport specialists has been a worldwide phenomenon; in North America, Britain, and western Europe the need for transport economists and transport planners had been met by the expansion of graduate education (including multidisciplinary training centers) and the establishment of numerous transport centers and transport institutes, usually associated with the universities. The research institutes not affiliated with a university are more important on the Continent; their training function, although often indirect or subsidiary to research, is very important. The Third World countries have had to rely on training in the North American or European institutions and large-scale use of foreign consultants. Of course, foreign consultants have their useful place, both as providers of specialized skills and experience that would be impossible or wasteful to develop within a country and as providers of different points of view that open the possibility of a search for different solutions (in this role, foreign consultants can play an important part in any country, including the most advanced). However, in many respects the employment of foreign consultants is bound to be the second-best solution; their understanding of the national constraints and style of operations (what will and what will not work) is bound to be inferior to that of the local professionals (provided that the local professionals have an equivalent level of expertise). In all cases, foreign consultants are more expensive. In a perfect world, the use of foreign consultants would be restricted to a few first-class specialists or firms that have specific expertise.

THE EXPERIMENT

Argentina is one of the more-advanced Third World nations: income is relatively high, potential wealth is vast (probably exceeding that of Australia or Canada), and the educational system is well developed, which includes an established and respected system of national universities. Argentina shares with Australia the problem of relative geographical isolation but, unlike Australia, it lacks well-established links with the scientific and professional centers of the British Commonwealth and North America. In Argentina, during the period after World War II, the development of postgraduate university education and advanced managerial training was neglected; subsequently, there was a shortage of professionals in planning and administrative fields. This shortage has also been felt in the transport sector; thus the government of Argentina decided to establish a training program for young professionals as part of the preparation of the National Transport Plan. Both the foreign component of the preparation of the National Transport Plan and the training program were financed by a loan from the International Bank for Reconstruction and Development (World Bank), which also provided some professional help and program supervision. In the case of the training program, the supervisory unit was the Economic Development Institute (EDI) of World Bank, which is its branch for training and professional development. Thus, the transport planning and transport economics (TPTE) course was born.

Although EDI has considerable experience in organizing and planning the program for training courses, this experience was not fully transferable in the case of TPTE. In general, EDI programs, both in Washington and in other centers, are geared to the training and upgrading of mid-level and senior professionals and administrators, whereas the TPTE program was designed for junior professionals who had little or no professional experience. Thus typical EDI courses are more like staff courses in government or industry, whereas the TPTE program had many characteristics of graduate training, although of a specialized type.

The program was developed and run as an Argentinian program the responsibility for which was fully accepted by the National Transport Planning Directorate of the Argentinian State Secretariat for Transport and Public Works (Dirección Nacional de Planeamiento de Transporte, Secretaría de Estado de Transporte y Obras Públicas). However, assistance and advice by EDI both at the initial program-development stage and during the course itself were of prime importance. The fine line between advice and assistance on the one hand and control and interference on the other was strictly observed in practice. It must be observed that EDI also cooperates with other countries in programs to train planners in which it also scrupulously observes their national and even ideological characteristics.

The basic choices made at the planning stage of TPTE were as follows:

1. The course was to provide extensive para-postgraduate specialist training for university graduates who were to be employed as transport planners and policy analysts in the government. The program length was 16 months, which included a practical work period of 2.5 months when the trainees were employed on projects within the Transport Planning Directorate.
2. The languages of instruction were to be English and Spanish. The use of English as the main language of instruction was justified on two grounds: (a) to enable young professionals to have direct access to literature in English, to participate in international conferences, and to work with foreign consultants employed in Argentina and (b) to make it possible to bring in as instructors individuals from outside the Spanish-speaking world and thus extend the range of suitable candidates.
3. The course was to have a strong analytical or methodological core; the accent was to be on the acquisition of analytical tools, which also implied providing the course participants with adequate training to be able to read professional journals to keep themselves up to date.
4. The selection of instructors was based on (a) demonstrated professional and teaching ability (academic criterion) and (b) extensive relevant experience in applied or professional fields (practical-experience criterion). In practice this implied the search for national or international civil servants and consultants who had academic experience and interests or for academicians who had extensive civil service or consulting experience. As was expected, the time constraints of the candidates approached made course scheduling difficult, particularly in the case of academic personnel, whose availability tended to be restricted by the university calendar.

THE PROGRAM

The program was divided into three parts: (a) the preparatory course (curso de nivelacion), which was aimed at giving the participants an adequate knowledge of English and at bringing the trainees to a common level of knowledge; (b) phase 1, devoted mostly to the acquisition of diagnostic skills and tool subjects; and (c) phase 2, devoted mostly to the problems of specific transport media, transport policy, and policy administration. There was a short break between the preparatory course and phase 1 and a period of practical work between phases 1 and 2.

Each stage, in turn, was subdivided into a number of minicourses one to three weeks long (English training during the preparatory course and transport economics in phase 1 were longer); in addition, a number of special lectures on different aspects of Argentinian transport were also arranged.

Each part of the program will now be discussed and the choices that had to be made and the results achieved will be reviewed.

The preparatory course was considered essential if the participants were to follow an intensive program of studies conducted partly in a foreign language. The alternative was to put stringent restrictions on language qualifications of the entrants.

The length of this part of the course was largely predetermined by the language-training requirement, to which about half of the teaching periods were devoted. English-language training, which was provided mainly by the British Council under a contract with the government of Argentina, fully succeeded in meeting its objectives: The trainees could follow lectures in English (by lecturers who had different accents), could use English-language material, and were able to communicate in English on professional matters. Spanish, however, was used for writing answers to tests and for project reports. During the other half of the time (268 teaching hours), the following subjects were taught: economics for engineers, mathematics for economists, advanced mathematics, statistics, introduction to computer programming, microeconomics, accounting and financial analysis, transport economics, and introduction to planning. The program was successful in bringing the group to a good common level of knowledge and its results were most useful in subsequent phases of the course. In retrospect, it appears that some changes would have been useful; for example, greater concentration on fewer subjects and a stress on the basic concepts rather than a survey-course approach would have been more effective.

The objectives of the second part of the course (phase 1) were to provide the trainees with the basic diagnostic and analytical tools and to introduce them to project evaluation and project analysis with special reference to transportation. Whereas the preparatory course was staffed entirely (except for language training) by local lecturers, more than two-thirds of the instructors for phase 1, including World Bank staff, came from abroad.

The basic choice in organizing this part of the training was whether to stress problem-solving skills by using case histories and case studies or whether to stress training in analytical methods. The second option was adopted. It was believed that, if the graduates of the course were not to become quickly out of touch and if they were to interact with foreign experts or consultants on a meaningful professional level, it was necessary to introduce them to the current state of the art as far as analytical techniques were concerned and, equally important, to provide them with the ability to read current contributions in professional journals. Of course, this choice was not meant to be dogmatic; in fact, the most successful minicourses combined formal teaching of the subject matter with exercises that related to applications of the techniques. In order to do this successfully, however, the length of the minicourses would have had to be extended, which would have caused a reduction in the number of subjects. In general, the concept of the minicourse proved to be successful, and it provided more flexibility than standard university programs do.

As was stated, the main emphasis was put on the diagnostic and related analytical tools. The subjects in this class were as follows:

1. Transportation economics: These questions were stressed: How does the transport system work? What interrelationships have to be considered in transport analysis?
2. Transportation-demand models: These were considered from two points of view: (a) their usefulness for the understanding of transport flows and modal split and (b) their usefulness as forecasting tools. The aim was not to develop model builders but model users and model specifiers.
3. Survey methods: In view of the key part that surveys play in the acquisition of transport information and of the perennial problem of adequacy and quality of data, survey methods are one of the most important diagnostic tools of a transport analyst. The aim of the course was not to teach how to design a survey but to teach how to specify a survey design, i.e., to provide the understanding of the problems of survey design and its interpretation as well as of the strengths and limitations of different approaches.
4. Financial analysis: This was also conceived as a diagnostic tool and was designed as a service course to provide the appreciation of the methods used.
5. Regional analysis and transport and agriculture: These two minicourses were aimed at setting selected transport problems in a wider context of regional development--transport interaction.

The prescriptive or normative part of phase 1 consisted of a minicourse on project evaluation as well as a number of special lectures that dealt with selected policy subjects. In total, phase 1 consisted of 122 teaching sessions (one-half day each) spread over four months.

In order to facilitate the integration of the trainees into the work of the directorate and to provide them with a feel for real-life operations, an interval of more than two months was arranged between phases 1 and 2. As is well known by the organizers of these so-called sandwich programs (training--practical work--training), the organization of a work interval requires considerable preplanning and careful management; experience with the TPTE course fully confirmed the dangers of underestimating these problems.

The last part of the course, phase 2, had the following objectives: (a) to give the trainees a more-thorough understanding of specific areas of transport operations (transport modes and urban transport) and (b) to introduce the trainees to problems of transport policy and implementation. In order to meet these objectives, the organization of phase 2 differed somewhat from that of phase 1: Specific minicourses were shorter, typically of one week's duration (the urban-transport minicourse was a notable exception), and greater use was made of special lectures, usually given by national specialists invited from industry or government. During this phase, class exercises and class projects per-

formed by small groups (to simulate office situations) replaced more-standard tests.

What was achieved? Today the former trainees are working in the Transport Planning Directorate, and feedback is very favorable. A small number of bright and well-motivated Argentinians have an informed interest in transport, demonstrate remarkable competence and self-assurance in tackling some difficult problems, and show a strong ability to get things done. The course director's ambition--to see his former trainees perform as well as his staff in a well-established research directorate in Canada--has been fully satisfied. The quality of the first reports and memoranda produced by TPTE graduates and their on-time production record are as good as those of young professionals in any equivalent office. If the Argentinian Transport Planning Directorate is allowed to continue its professional development (the group as a whole shows good promise and enjoys a remarkable leadership), this office should become a serious center of applied transport studies and gain international recognition.

LESSONS

The training program described above was an experiment. The value of experiments depends on what was learned and on how the lessons can be applied. In order to assess the TPTE experiment, it appears useful to compare the program with other training options.

Program Inside a Country Versus Training Outside

One of the alternatives to a program of this type is graduate training in the universities outside the country. In fact, training in foreign universities is by far the most common way of supplementing education in national universities. The relative advantages are (a) that training at a good foreign institution provides more than professional education--it also gives experience in living and learning in another country and an opportunity to establish friendships and professional contacts--and (b) that an established university provides a good library, a wide range of courses, and programs developed through long experience. Against these advantages, the following disadvantages must be noted: (a) living and studying in a foreign language and in a different culture produces considerable stress, which results in a relatively large rate of incompleted studies, barely completed degrees, and longer-than-anticipated training periods; also, in order to complete a degree, a much higher level of knowledge of the language is necessary; (b) the programs reflect (consciously or subconsciously) concerns, traditions, and institutional patterns of the country in which the university is located and thus they may not be fully geared to the needs of a foreign student; and (c) the advantage of group interaction of young professionals who have common interests and similar career aspirations is lost. On balance, it appears that, valuable as foreign institutional training is, it should be regarded as a complement and not as a substitute for training at home.

Postgraduate Training Versus Training Within a Government Unit

The role of graduate and professional schools in training a country's executive and professional classes is so well established in most of the advanced countries that the search for alternatives is rarely, if ever, considered. Graduate and professional schools are, of course, more than training centers, their strength stems from a fruitful combination of research and teaching in which there are all types of linkage between fundamental and applied research, sponsored or problem-directed and free research, research and teaching, and graduate and undergraduate training. The combination of these different roles also provides them with more-efficient utilization of facilities (libraries, laboratories, computer centers, common rooms, etc.). Finally, the independence of academic institutions permits them to become centers of new ideas, policy criticism, and policy development. All these are overwhelming advantages and teaching in a combination of research institute and graduate school is most likely the preferred manner of organizing both research and training. However, the problems in following this route are not theoretical but practical. First, it takes years of continuing tradition and adequate provision of resources to develop such institutions; unfortunately, time is short and training needs are immediate. Second, the very strengths of the universities--their multiproduct (teaching and research) characteristics, variety of mutually supportive programs, and quality control by means of strict degree requirements--produce certain rigidities. (For example, in those institutions in which a course system exists, courses tend to be of similar length, e.g., session, semester, trimester, whereas in an independently designed program full flexibility of course length can be achieved.) Third, the rationale for tests and examinations is somewhat different. A standardized (fair) assessment of individual achievements and differentiation among individual results is of secondary importance, whereas development of problem-solving ability by small teams (i.e., simulation of working conditions) becomes of primary interest.

Obviously, differences noted above are somewhat overemphasized to contrast the relative advantages of the two systems of training. A well-designed graduate program can accommodate needs for flexibility and simulated working conditions. On balance, I would prefer to see advanced professional training conducted at a well-established institute devoted to research and graduate work and affiliated with a university; nonetheless, difficulties in organizing and developing such an institution often make this solution impractical in the short run. Under such conditions, a program organized within a government planning or research unit is not only a workable alternative but also a practical interim solution. Furthermore, although the sponsoring unit must bear the costs (both in terms of money and of the lack of time of senior officials) of the training arrangement, it gains not only by the upgrading of its professional staff but also indirectly by the exposure to and interaction with the specialists invited to teach in such a course.

Specialized Versus More-General Training

The program described in this paper was specifically geared to the needs of one government department or one specialized sector of the economy. This solution has both advantages and disadvantages. The advantage is that the program can correspond closely to precisely identified needs of one sector; thus the training is fully relevant for the needs of immediate employment. The disadvantages of this solution are that (a) the needs of a particular department or sector may not justify the continuation of the training program and thus the utilization of the experience gained; (b) future careers of the trainees are impossible to predict and a more-general program would give them somewhat greater flexibility; and (c) there exist opportunities of fruit-

ful transfer of experience between the sectors. For example, work on the peak problem pioneered was in the context of electricity supply, which was and is of direct relevance to transport; work on cost forecasting and learning functions that originated in the airframe production industry has potentially wide applications in the fields of maintenance and forecasting construction costs; and benefit/cost analysis was first developed in water resource management. Also, management, information systems development, and policy administration are not sector specific, and these are the areas in which professional training is particularly needed in most countries.

An example of a workable combination of related sectors would be transport--communications--energy (i.e., an infrastructure sector program). It is impossible to determine on an a priori basis the balance between advantages and disadvantages of more-specific versus more-general programs. The practical considerations (as usual) have to prevail: What is feasible under the given circumstances? How much interest in a specific program can be generated among senior staff and where do the recognized training needs exist? Clearly, a strong and direct interest by senior staff is essential for the success of a program of this nature. The advantage enjoyed by the TPTE program in Argentina was that both the Transport Planning Directorate and World Bank were interested in its success.

National Versus International (Regional) Program

Argentina is a large, advanced, wealthy country; thus it could afford to develop a program of its own. This is, however, a special situation. The question thus arises, Could the advantages of a national program be maintained if it were organized for a group of countries in the same region that shared similar cultural and institutional backgrounds and similar problems? An international or regional program would obviously enjoy the potential advantages of economies of scale and continuity. The key questions remain: Could the program also generate strong sustained interest within the countries associated in the scheme? Could it acquire a style of its own that would be consistent with the character of the region or would it become a distant, or foreign international, organization? Who could take the leadership role and how could the leader be prevented from dominating the program to the extent that the feeling of participation by weaker partners would disappear? There exists considerable experience in international (regional) educational research centers that range from well-developed international graduate schools to more-specialized establishments. It would appear that, with the assistance of international institutions, development of more research-training regional centers that specialize in transport-infrastructure planning would meet the long-run needs of many of the Third World regions, provided that they obtained full support of the countries involved and were adopted by them as their own foundations rather than as another set of international (foreign) institutions.

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This paper is based on my experience as a director of the transport planning and transport economics course in Argentina in 1979-1980. Although I assume full responsibility for the review of this experience and the opinions expressed in discussing it, I owe (directly or indirectly) all the ideas to those who were responsible for the organization, supervision, and conduct of the course. In particular, I am indebted to Vincent Hogg (formerly of EDI, now of Central Projects Staff, World Bank); to Jorge H. Kogan (Dirección Nacional de Planeamiento de Transporte y Obras Públicas, Argentina), who conceived the idea, made it happen, and gave full support to the program; to Carlos A. Basco, who provided constructive supervision and advice and was able to resolve numerous problems that ranged from the most fundamental to the most practical; and to P. Malone (EDI, World Bank), who has been most helpful throughout the project. The members of the assessment team (A.H. Petrei, R. Izquierdo, and G. Murray) forced me to crystallize and reassess my ideas on future training options, and I learned much from their comments. And, of course, the most critical and useful lessons were learned from the trainees themselves.

Who Reads the Transportation Planning Literature?

GERALD S. COHEN, FRANK McEVOY, AND DAVID T. HARTGEN

This paper reviews the role of professional journals in transportation planning and evaluates the degree to which the literature is used. A stratified random sample of professionals in eight separate work settings was drawn and sent an extensive questionnaire on journal-reading habits, preferences for journal characteristics, and uses made of specific journals. Results show that the most popular journals (based on percentage of professionals who read them) are the Transportation Research Board Record (76 percent), National Cooperative Highway Research Program reports (57 percent), Institute of Traffic Engineers (ITE) Journal (56 percent), the Transit Journal (48 percent), and Traffic Quarterly (48 percent). But overall time spent reading is low; collectively the 17 major journals in transportation are read on the average of 7 h/month by the average professional. Reading professional literature is a low-priority activity; journals are scanned, generally on receipt, for relevant articles, which are rarely read thoroughly. The average professional sees 5.6 journals per month. The ideal journal has middle-of-the road articles that center on a balance of theory, practice, modal focus, and policy subjects. The most popular journals are those that contain such mixes and provide the professionals with general awareness and information on new practical techniques for use in their own work. The paper concludes that, if transportation professionals are not avid readers of their professional journals, they are at least avid scanners who continuously search a number of sources for relevant material. The incidence of journal use could therefore probably be substantially increased by increasing the direct relevance of the published material to the needs of the practicing professional.

Like other policy-oriented academic fields, transportation planning has come to rely greatly on publications for the interchange of ideas. Government agency publications and a myriad of professional journals have significantly increased the volume of material published in order to serve this role adequately.

In recent years many in the field have come to realize that the study of transportation-related phenomena is not confined to engineering and public policy analysis. Disciplines like psychology, marketing research, geography, and others have made important contributions to a more-complete understanding of the transportation process.

Even in the face of this progress there remains, to a certain degree, an information gap between the academic researcher and the day-to-day practitioner, and vice versa. This may result in part from the extreme rapidity with which changes have occurred within the profession over the last 15 years.

In a recent paper, Hartgen referred to transportation planning as "having undergone vast changes in objectives, structure, and approach over the last 15 years. Those of us who have been associated with it and have seen the changes close up often have been amazed at their rapidity" (1, p. 1). Techniques widely used for many years have often been outpaced by this rate of change. The profession overall has undergone a major change of focus from evaluation of large-scale, capital-intensive, long-term projects to smaller-scale, capital-efficient concerns. Accompanying this refocus is the parallel change of techniques required. This point has been well outlined in the literature of the 1970s. Specifically, the profession has addressed the inadequacy of older techniques with attempts to gain a fuller understanding of the role of behavior and behavioral science and a move toward greater acceptance of new evaluation methods. Recent research has progressed to update and refine these methodologies even further. It is unreasonable to assume an end to this process of definition and refinement in the near future.

In this light one key role of the professional journal is the ongoing exchange between researcher and practitioner. It is through this exchange and others that practitioners remain reasonably well informed about progress in the discipline.

Yet it appears that little or no research has been done to directly evaluate the role of these publications in transportation studies. It is obvious that no two professional journals have exactly the same content or focus, which makes direct comparison difficult. Rather, an attempt is made here to compare the general characteristics of publications. Preference and demographic data and other information collected about readers are evaluated in an attempt to define the type of journals preferred by the professionals sampled. By undertaking this research we have attempted to establish the interaction between reader profiles and the professional journals that are being read. Other objectives are also evaluated by this research: determination of the commonly used professional journals and the pattern of their use and examination of the extent to which these professional journals contribute to the exchange of ideas within the field.

SURVEY DESIGN

In an effort to collect data that would shed light on the objectives outlined above and to allow further study, the Planning Research Unit of the New York State Department of Transportation (NYSDOT) in cooperation with the Department of Geography, State University of New York at Albany, conducted a mail-out survey of 400 randomly selected transportation planning professionals in the spring of 1980. The survey was designed and conducted to gain adequate representation of various subgroups within the transportation planning profession. A large portion of the progress in research has been due to the planning and policy analysis subgroups of transportation.

The mailing list compiled and maintained by the Planning Research Unit was taken to contain a cross section of the professionals we wished to sample. The list was used as the basic sampling frame. For purposes of this research, 200 individuals were randomly selected from the mailing list for the preliminary research report. Specific proportions were allocated judgmentally and care was taken to ensure the efficiency of the sample. Allocation was made on a judgmental basis rather than through calculation because the underlying parameters of this population were not readily available. Still, it has been shown that, from a practical point of view, moderate sample sizes are often sufficient. Significant conclusions can be drawn from surveys that have sample sizes as small as 100 respondents. A reasonably high response rate was expected from those surveyed, which further reduced the necessity of a large, expensive mailout survey. The actual response rate was moderate, perhaps because of the great length of the questionnaire and the fact that no return envelope was included. The original groups selected and the rates of return are shown below:

Subgroup	Sample Size	Number of Responses Group 1	Group 2
School	80	11	4
Consultant	80	10	6
Regional planning group	80	15	10
Other state transportation department	80	12	9
Federal government	40	10	2
Transit authority	40	6	6
	400	64	37

Individuals were selected in an effort to produce a significant number of responses for several population subgroups. Samples from each list were drawn systematically by using random numbers. Accompanying each primary questionnaire was a second copy marked with a red S. The secondary questionnaires were distributed based on the following instructions included in the introductory letter:

1. Identify the major part or parts of your organization that deal primarily with transportation planning, development, environment, or administration, e.g., a planning division. Exclude those parts that have as their primary functions design, construction, maintenance or operations, and administration or staff functions.
2. From this group, select that professional-rank individual whose last name most closely follows yours in the alphabet; if yours is the last such name alphabetically, continue to the beginning of the alphabet.

These questionnaires represent the second group of the survey and were included to ensure a wider distribution and representation in responses from the various subgroups, since it was believed that the initial mailing list might have contained individuals who had a greater propensity to read professional journals than others. Inclusion of this second sample resulted in doubling the original mailing to 400. Of the 400 questionnaires sent out, 101 were received in complete-enough form to be included in this analysis. Data on the journals examined in this study are given in Table 1.

ANALYSIS AND RESULTS

In the next sections we will analyze the responses

Table 1. Major journals in transportation planning and policy analysis.

Name	Publisher and Place	Frequency of Publication	Subscription Rate ($) Regular	Member
Transportation Research	Pergamon Press, Elmsford, NY			
Part A		Bimonthly	121	
Part B		Quarterly	75	
Both			187	
Journal of Transport Economics and Policy	London School of Economics and Political Science, England	Three times yearly	50.70	
ITE Journal	Institute of Transportation Engineers, Arlington, VA	Monthly	13	10
Transportation Science	Transportation Science Section, Operations Research Society of America, Baltimore, MD	Quarterly	30	Less
Transportation Engineering Journal	American Society of Civil Engineers, New York, NY	Bimonthly	30	12.50
Transit Journal	American Public Transportation Association, Washington, DC	Quarterly	18	
Transportation	Elsevier Scientific Publishing Co., Amsterdam, Netherlands	Quarterly	44.10	
Transportation Research Board (TRB)	Transportation Research Board, Washington, DC			
Record		Continuous	Varies	
Special Report		Continuous	Varies	
Transportation Planning and Technology	Gordon and Breach Science Publishers, London, England	Two volumes yearly	137.50	
Journal of Advanced Transportation	Institute for Transportation, Durham, NC	Three times yearly	50	
Traffic Quarterly	Eno Foundation for Transportation, Westport, CT	Quarterly	Free	
Transportation Journal	American Society of Traffic and Transportation, Chicago, IL	Quarterly	20	Free
Public Roads	Office of Research and Development, U.S. Department of Transportation	Quarterly	7.60	
National Cooperative Highway Research Program (NCHRP) reports	National Cooperative Highway Research Program, Washington, DC	Continuous	Varies	
NTIS abstracts	National Technical Information Service, Springfield, VA	Continuous	Varies	
HRIS Abstracts	Highway Research Information Service, Washington, DC	Continuous	Varies	

Note: Subscription prices are as of 1980.

to a number of issues addressed by the study. The data have been stratified so we can see whether the nature of the responses varies by any of the following:

1. Readership of a given magazine: For example, we might expect to find that a higher proportion of those who read Transportation Research, Part A, will have advanced degrees than does our data set as a whole.
2. Nature of employer: For example, we might expect that the distribution of salaries might be different for those employed by consultants or schools than it would be for the data set as a whole.
3. Nature of job: For example, we might expect that the number of journals read per month would vary with one's duties.

General Reading Habits

Journal Popularity

The percentages of readership of the 17 journals mentioned are shown below:

Rank	Journal	Readership (%)
1	TRB Record	76
2	NCHRP reports	57
3	ITE Journal	56
4.5	Traffic Quarterly	48
4.5	Transit Journal	48
6	Transportation Research, Part A	42
7	Transportation Engineering Journal	40
8	NTIS abstracts	34
9	HRIS Abstracts	30
10	Transportation Research, Part B	29
11.5	Public Roads	20
11.5	Transportation	20
13	Journal of Transport Economics and Policy	12
14	Transportation Science	10
15	Journal of Advanced Transportation	8
16	Transportation Journal	8
17	Transportation Planning and Technology	3

Of the journals surveyed, the TRB Record and NCHRP reports were the most popular, read by 76 and 57 percent of respondents, respectively. ITE Journal was a close third, read by 56 percent. Journals less frequently read tended to be foreign or international in content or highly specialized.

Because of particularly small sample sizes associated with some journals, the remainder of our analysis generally concentrates on those journals for which we have sufficient information to draw statistical conclusions. These are in general the first nine publications listed above, although others are included on occasion of interest.

Time Spent Reading or Using Professional Journals

It is generally believed that transportation analysts spend much time reading the professional literature; this is not so. The mean time spent reading professional journals is 6.99 h/month (the average analyst in our profession spends less than 5 percent of his or her work time reading the professional literature). The results given in the tabular material below are based on the following percentages of all responses for hours per month spent reading professional literature (not hours spent reading each journal but total hours spent reading by readers of each journal, since such readers usually read other journals too):

Time Spent Reading (h/month)	Percentage of All Responses
1	3
1-3	24
4-6	41
7-10	13
11-15	12
16-20	6
21+	1

The breakdown by journal (in average hours per month) is as follows (N = number of readers in the sample):

Journal	N	Avg (h/month)
Transportation Research, Part A	42	6.58
ITE Journal	56	7.65
Transportation Engineering Journal	40	8.13
Transit Journal	48	6.16
TRB Record	76	6.91
Traffic Quarterly	48	7.60
Transportation	20	5.90
NCHRP reports	57	8.74
NTIS abstracts	34	6.50

The breakdown (in average hours per month) in terms of type of work of reader is planners, 5.07; administrators, 7.41; researchers, 9.60; and teachers, 6.34. By employer, the average number of hours per month spent reading professional literature breaks down as follows:

Employer	N	Avg (h/month)
Federal government	12	6.05
New York State (NYS) regional planning agency	9	7.54
Transit agency	12	4.83
State department of transportation	21	7.36
Regional planning agency not in New York State	16	5.12
Consultant	16	5.09
School	13	8.96

Readers of NCHRP reports are the most avid (8.74 h/month); readers of Transportation, the least avid (5.90 h/month). General reading rates are highest among researchers and school employees (professors and students) and lowest among planners and employees of transit agencies, followed closely by consultants. Some would say that this reflects the general relevance of the journals to the practicing profession.

Number of Journals Read

Only about 4 percent of the sample does not read any journals; 75 percent of those surveyed read at least four journals. The mode for our survey is five journals. Results showed that federal employees and employers of consultants read at least one journal. There is one surprising result: Although 8 percent of those who work for schools do not read any journals, all the teachers read at least four. This suggests that a number of those engaged in research who are employed by colleges and universities read no professional journals. This is consistent with the 20 percent of all researchers who indicate that they read no professional journals. Sample sizes, of course, are too small to be sure of the significance of this result, but the numbers do suggest that some researchers in schools do not find any of the current journals useful and that there may be a gap that needs to be filled.

Combining the average number of hours spent reading (6.99) with the average number of journals read (5.95), we note that the average journal is read 1.17 h/month by the average professional.

Allocation of Time Spent Reading

General journal reading is a haphazard activity that is done on the spur of the moment and has fairly low priority. Approximately 82 percent of those sampled indicate that they read journals on receipt, they read them if they have the time, or they allocate time for reading journals differently for different needs. Almost no one sets aside a specific amount of time daily or weekly for reading. Readers of the less widely read journals are more likely to read journals only if they find the time. Those who work for either the federal government or the schools are most likely to be influenced by specific needs in deciding to read journals. Sampled employees of regional planning organizations are more likely to set aside time weekly than those in the data set as a whole. Teachers appear to vary their reading habits according to specific needs.

Characteristics of Readers

Nature of Work

Relatively few of those sampled indicated that they did much location planning or (more surprisingly) project development and implementation. This may well be due to the nature of the sampling frame. The pattern shown when the data are stratified by readership of particular journals varies somewhat less than might be expected. It was noted that users of NCHRP reports and Traffic Quarterly are somewhat less likely to do a good deal of program management.

Those who work for schools do the bulk of their work in research and teaching. However, 16 percent of those who work for schools spend most of their time on policy formulation or system planning. Over half of those in our sample who are employed by New York State (NYS) regional planning agencies describe the bulk of their work as policy formulation as do 25 percent of those in our sample who work for the federal government.

The administrators in our sample indeed do a good deal of program management but a plurality of our sampled administrators describe their work as policy formulation. The planners sampled tend to be engaged in program planning.

Salary

Publishers of magazines for the general public are often pleased to discover that their readers are particularly affluent. Perhaps then the publishers of Transportation can be happy in spite of their somewhat low circulation among those sampled: 40 percent of the readers of Transportation that were sampled in our survey earn $40 000 or more, a sum earned by only 15 percent of our survey as a whole. In contrast, only 10 percent of the sampled readers of the Transit Journal earned $40 000 or more.

Only 24 percent of those sampled who worked for state departments of transportation (DOTs) earned $30 000 or more, whereas 67 percent of those sampled who worked for the federal government earned this figure. These results may be caused by the nature of the list used to obtain respondents. More significant, however, is that 90 percent of those who describe themselves as planners earned less than $30 000, whereas only 38 percent of the administrators and 36 percent of the teachers in our survey earned less than $30 000.

Education

Our sample has a very large number of persons who have doctoral degrees. This is partly because 85 percent of those who work for a college or university have the advanced degree. In our sample the master's degree is much more common than is the bachelor's degree. A higher proportion of the readers of Transportation seem to have a Ph.D.,

whereas the journals that have the largest proportion of M.S. degrees among their readers are the Transportation Engineering Journal and the ITE Journal. (The latter result is certainly not unexpected.)

The doctoral degree occurs most often in our sample for employees of the federal government and of colleges and universities. The bachelor's degree is most common among employees of state DOTs. It is interesting to note that there are more administrators with B.A.'s than with B.S.'s in our samples, although the difference is not significant.

Professional Membership

Generally, almost everyone sampled belongs to four organizations or less; approximately 13 percent of those sampled belong to no professional organization. The readership of particular magazines does not seem to relate strongly to the number of organizations to which one belongs. The average number of organizations to which readers in the overall distribution belong is 1.87. The results given in the following tabular material are based on the following percentages of professional membership:

No. of Organizations	Percentage Who Belong
None	13
1	31
2	27
3	21
4	7
5	0
6	1
7	1

The breakdown by journal of average number of professional organizations to which readers belong is as follows:

Journal	Avg No. Organizations
Transportation Research	1.75
ITE Journal	2.36
Transportation Engineering Journal	2.69
Transit Journal	1.92
TRB Record	2.09
Traffic Quarterly	2.16
Transportation	2.20
NCHRP reports	2.19
NTIS abstracts	1.83

The breakdown in terms of type of reader is planners, 1.53; administrators, 2.17; researchers, 2.20; and teachers, 2.34. By employer, the average number of organizations breaks down as follows:

Employer	Avg No. Organizations
Federal government	1.23
NYS regional planning agency	2.31
Transit agency	1.24
State DOT	1.44
Non-NYS regional planning agency	2.34
Consultant	2.16
School	2.62

Readers of magazines sent to members (ITE Journal, Transit Journal) are slightly more likely to belong to an organization. The users of NTIS abstract services and NCHRP reports are, on the other hand, slightly more likely not to belong to any organization.

All the teachers belong to at least one organization, but 24 percent of the planners do not belong to any organization. A plurality of the sample belongs to one organization, but an almost equal number belongs to two.

Almost 30 percent of those who work for state DOTs do not belong to any organization and another 30 percent belong to only one. This may be in part because the states often have general memberships in these organizations and can pass the states' organizational benefits on to their staff. All of those employed by schools are members of at least one organization, and most of those in this category who were sampled belong to at least two or three.

General Preferred Characteristics of Journals

Range of Subject Matter

Those questions that dealt with a 5-point scale used to rank characteristics of professional journals that the respondent finds useful proved somewhat disappointing. Respondents tended to avoid extremes and only a few patterns emerged. Respondents were asked to indicate their preference on a 5-point scale on which only the end points were labeled. The end given a score of 1 was labeled "concentrates on one subject area" and the end given a score of 5 was labeled "covers many different areas."

Almost no one wanted a journal that concentrated on only one subject area. Administrators were strongest in support of journals that deal with many different areas. The reader of both Transportation Research and Traffic Quarterly showed some tendency toward preferring a narrower range of subject matter. None of those employed by colleges or universities selected the score that suggested the strongest support for many different areas.

Treatment of Theory

Everyone wanted a happy medium in this area. No one selected the end point "very theoretical," and there was little support for a journal that had no theoretical content.

With every response near the mode, there was little variance when the data were stratified. Readers of Transportation showed a preference toward more theory, whereas readers of the Transit Journal showed a dislike for theory. Only 5 percent of those who worked for a state DOT indicated a preference for a good deal of theoretical content. As expected, researchers and teachers gave the strongest support for theoretical content.

Orientation to Mode

There was only limited support for a journal that concentrated on one specific mode, but there was moderate support for a journal that was strongly multimodal.

Only employees of state DOTs and consulting firms expressed interest in a journal that dealt with one specific mode. Readers of the TRB Record seemed to be particularly supportive of a multimodal journal. Administrators and researchers were most in favor of a strongly multimodal journal.

Treatment of Policy

Respondents were asked to rank on a 5-point scale that had the end "no coverage of policy issues" coded 1 and the end "comprehensive coverage of policy issues" coded 5. There were very few answers at either end point. Teachers and researchers were less interested in policy-oriented journals. Most of the sample (56 percent) selected the middle rank of 3. Readers of Transportation were most in favor

of a comprehensive coverage of policy issues.

Characteristics of Specific Journals

Each person who indicated that he or she read a given journal was also asked questions about that journal. Again, because it is difficult to draw conclusions when sample sizes are small, we will concentrate our analysis on the nine journals that we have looked at closely before.

What Journals Do You Read?

Tables 2 and 3 show the characteristics of the readers of each of the 17 journals studied. Sample-size problems prevent conclusions in some cases, but the following trends are apparent:

1. Planners constitute a greater share of the readership of the ITE Journal and NCHRP reports than the average;
2. Administrators make up a greater share of the readers of the Journal of Transport Economics and Policy, Transportation Engineering Journal, and the TRB Record than the average;
3. Researchers and teachers make up a greater-than-average share of the readers of Transportation Research, Part B, Transportation Science, Transportation, and the NTIS abstracts;
4. Employees of the federal government make up a greater-than-average share of the readers of Transportation Research, Part A, Transportation, and Traffic Quarterly; and
5. Employees of state DOTs constitute a greater-than-average share of the readers of NCHRP reports, NTIS abstracts, and HRIS Abstracts.

How Much Time Do You Spend Reading Specific Journals?

In most cases, it appears that less than 1 h/month is spent reading any given journal. More time appears to be spent reading the TRB Record than is spent on any other journal. Only 28 percent of all those who read TRB publications spend 0.5 h or less

Table 2. Readership by work activity.

Name	Sample Size[a]	Percentage by Type of Work			
		Planner	Administrator	Researcher	Teacher
Transportation Research					
Part A	42	33	40	10	12
Part B	29	34	31	14	14
Journal of Transport Economics and Policy	12	17	58	0	17
ITE Journal	56	36	41	9	11
Transportation Science	10	10	30	20	8
Transportation Engineering Journal	40	25	50	13	0
Transit Journal	48	33	42	4	13
Transportation	20	20	35	15	20
TRB Record	76	32	43	9	13
Transportation Planning and Technology	3	100	0	0	0
Journal of Advanced Transportation	8	62	25	13	0
Traffic Quarterly	48	31	42	10	15
Transportation Journal	8	25	38	0	38
NCHRP reports	57	37	37	12	11
NTIS abstracts	34	29	32	18	12
HRIS Abstracts	30	30	27	20	17
Public Roads	24	29	33	21	8
Avg		34	40	10	11

[a]N = 101.

Table 3. Readership by employer.

Name	Sample Size[a]	Percentage by Employer						
		Federal Government	NYS Regional Planning Agency	Transit Company	State DOT	Non-NYS Regional Planning Agency	Consultant	School
Transportation Research								
Part A	42	19	5	10	23	14	14	19
Part B	29	14	7	10	24	10	21	14
Journal of Transport Economics and Policy	12	8	0	0	17	8	33	33
ITE Journal	56	9	11	7	16	23	20	14
Transportation Science	10	10	10	8	20	10	20	13
Transportation Engineering Journal	40	13	18	0	23	15	20	13
Transit Journal	48	13	8	21	15	13	17	15
Transportation	20	20	10	0	20	5	25	20
TRB Record	76	12	8	9	22	16	18	14
Transportation Planning and Technology	3	33	0	0	0	33	33	0
Journal of Advanced Transportation	8	13	13	0	25	25	25	0
Traffic Quarterly	48	15	13	6	13	15	21	19
Transportation Journal	8	13	0	0	0	25	13	50
NCHRP reports	57	11	9	9	26	12	19	14
NTIS abstracts	34	12	3	15	32	12	18	9
HRIS Abstracts	30	7	3	10	40	7	17	17
Public Roads	24	13	8	8	29	13	13	17
Avg		12	9	12	21	16	16	15

[a]N = 101.

reading them. In contrast, only 14 percent of those who read the Transit Journal devote more than 1 h/month to using it. A large percentage (45) of the readers of Transportation spends less than 15 min/month reading it.

How Do You Receive the Journal?

The answers to this question show some interesting patterns (Table 4). The journals associated with membership in an organization, such as the ITE Journal and the Transportation Engineering Journal, show a high proportion of readers who have a personal subscription. For most of the other journals, readers use company subscriptions. Some of the more-technical journals such as Transportation Research and Transportation are often borrowed from a library. It is interesting to note that the journals most likely to be obtained by borrowing from a friend or associate are those journals that have a high proportion of individual subscribers.

How Do You Usually Read the Journal?

From 10 to 20 percent of all respondents read a journal by scanning the table of contents. Apparently abstracts are less useful than might be expected since few of those sampled used the abstracts to decide which (if any) articles to read. Most of our sample approach journals by scanning or reading selected articles. A slightly higher proportion of the readers of Transportation read it from cover to cover, but the sample size is too small to draw conclusions.

What Is the Major Focus of Articles You Prefer?

It appears that readers of many of the journals are particularly interested in reading about issue-oriented studies (Table 5). NCHRP reports are most widely preferred as being valuable when one is writing about applied procedures. In fact, readers of the most popular journals prefer the articles on applied procedures and issue-oriented studies.

What Is the Primary Function of Your Reading?

For most readers the primary function of reading was to assist general awareness, to learn new techniques, or to follow the development of programs. More often than any other journal, the TRB Record was described as the journal to read "because it publishes my work." NCHRP reports are considered particularly useful for describing new techniques. Transportation Research, Part A, the Transit Journal, and Traffic Quarterly rate high on providing general awareness.

SUMMARY AND IMPLICATIONS

Many observations can be made by examining the data in the tables, and the reader is encouraged to do so. It would have been very difficult to obtain a timely random sample. The procedure used that involved the Planning Research Unit's mailing list probably has introduced bias. In particular, the distribution of degrees is surely skewed toward professionals who have advanced degrees. Since in many cases the potential bias is difficult to estimate, one should be cautious about extrapolating conclusions to the entire field of transportation planning. Some of the major observations that can be made are as follows:

1. Most professionals spend less than 7 h/month (less than 5 percent of work time) reading journals. Less than 1.2 h/month is generally spent on any given journal. However, a fairly large number of journals (5.6) are seen by the average professional each month.
2. More than 80 percent of those professionals who describe themselves as planners spend less than 7 h/month reading journals. Those who work for schools generally spend a good deal of the time reading journals.
3. Almost everyone sampled was a member of at least one professional organization; however, few are members of more than three organizations.
4. Journal reading is haphazard and low priority

Table 4. How journals are received.

Name	Sample Size	Percentage by Source				
		Personal Subscription	Office	Library	Friend or Associate	Other
TRB Report	76	26	58	4	4	4
NCHRP reports	57	25	63	4	5	2
ITE Journal	56	50	27	9	13	2
Transit Journal	48	6	67	19	4	2
Traffic Quarterly	48	17	58	19	4	2
Transportation Research, Part A	42	17	52	24	2	2
Transportation Engineering Journal	40	45	30	10	13	3
NTIS abstracts	34	3	74	9	0	9
Transportation	20	15	40	35	0	5

Table 5. What major focus of articles is preferred.

Name	Sample Size	Percentage by Issues Preferred								
		Modeling	Case Studies	System Planning	Modal Planning	Program Management	Issue Orientation	Applied Program	Theoretical Work	Other
TRB Report	76	9	8	16	5	5	14	22	4	4
NCHRP reports	57	4	5	14	4	9	16	33	0	7
ITE Journal	56	0	18	13	4	5	20	27	2	5
Transit Journal	48	0	17	4	15	13	23	15	0	2
Traffic Quarterly	48	4	10	13	6	10	29	15	0	2
Transportation Research, Part A	42	7	2	21	7	2	17	10	12	5
Transportation Engineering Journal	40	3	15	10	3	8	23	18	8	5
NTIS abstracts	34	3	12	6	9	9	32	9	3	3
Transportation	20	10	5	5	0	10	35	0	15	5

and occurs most often immediately on receipt. Readers review magazines by scanning or reading articles. The abstract is not used to make the decision to read or not to read.

5. Ninety percent of those who describe themselves as planners earned less than $30 000, whereas only 38 percent of the administrators and 36 percent of the teachers in our survey earned less than $30 000.

6. Almost no one was interested in a journal that concentrated on only one subject area. Well-balanced subject matter, theory, modal treatment, and policy issues are preferred.

7. Most readers obtain their journals through office or firm subscriptions, but journals associated with organizations have a high proportion of readers who have individual subscriptions.

8. Readers are most interested in reading about issue-oriented studies and applied procedures. The most popular journals are those that focus on these topics.

9. Few journals have a narrow readership. Content of specific articles much more than association or name is what determines whether journals are read.

10. The primary function of most journals for their readers is to provide general awareness and information on new techniques.

The picture that emerges is of a dichotomy between reader and literature. On the one hand there is the busy professional who scans a number of journals and their articles (not abstracts) for issue-oriented studies and applied procedures. Apparently few are found, since this only takes 7 h/month. On the other hand there is a growing number of journals, each of which offers a slightly different selection of articles. Through experience, exposure, and membership, our busy readers have learned in which journals to find material to their taste, and they focus on those publications. The image of a narrow-subject reader who immerses himself or herself in one journal or topic is a myth.

If only 5 percent of the professional's time goes to reading journals, what other reading is done? We have no evidence but suspect that, of the 30 percent or so of the professional's time spent reading, 20 percent goes to office material and subsurface professional literature and perhaps 5 percent to trade publications of various sorts. We have not studied these sources here; we leave that for a later effort. But one thing is clear: If 17 journals are collectively publishing material on which only 5 percent of the average professional's time is spent, then that literature must be collectively irrelevant.

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State and Regional Roles in Public Surface Transportation: Education, Training, and Research Contribution of Universities

MICHAEL D. MEYER AND ROBERT E. PAASWELL

This paper presents the results of two panel discussions that focused on the education, training, and research contribution of universities in helping state and regional transportation agencies identify and solve local problems. The panelists identified five areas in which universities can make important contributions—policymaking, formal education and training, continuing education, special training programs, and technical assistance. However, universities are facing serious problems in financial support and enrollment that could potentially reduce the role that universities play in helping transportation agencies in the future. In terms of research, the panelists distinguished between long-term (basic) and short-term research, identified a strong need for diversity in problems on which universities can work, discussed the need for continuity of research funding, and outlined the characteristics of a university that make it unique for investigating transportation problems. It was concluded by both panels that a dialogue between the universities and the transportation agencies must be established to ensure better integration of university capabilities into transportation policymaking.

Over the past several years, state and regional agencies have become actively involved in the planning, management, and financing of passenger transportation services. To examine some of the issues being faced by these agencies, the Transportation Research Board sponsored a conference in the summer of 1980 that brought together a diverse group of transportation professionals who were concerned with some aspect of the emerging roles being played by state and regional agencies. Two conference sessions were devoted specifically to the potential contribution of universities in supporting the needs of these agencies. The first session, Transportation Education and Training Needs, focused on the role that universities play in providing the educational and training opportunities for existing and future transportation professionals. The following participants were present: Frank Enty, Urban Mass Transportation Administration (UMTA); Harry Heiges, U.S. Department of Transportation (DOT); Chester Higgins, Massachusetts Bay Transportation Authority; Byron Lewis, Southern California Rapid Transit District (SCRTD); John Fuller, University of Iowa; Les-

ter Hoel, University of Virginia; Michael Meyer (session chairman), Massachusetts Institute of Technology; and Louis Pignataro, Polytechnic Institute of New York. The purpose of the second session, State and Regional Research Needs--The University Role, was to examine the conduct of transportation research at universities and to determine how universities could better contribute to the identification and solution of local problems. The participants were Thomas Larson, Pennsylvania Department of Transportation; Louis Pignataro, Polytechnic Institute of New York; Robert Ravera, Transportation Systems Center; Sandra Rosenbloom, University of Texas at Austin; Arthur Saltzman, North Carolina Agricultural and Technical State University; and Robert Paaswell (session chairman), State University of New York at Buffalo. The purpose of this paper is to summarize the results of these two sessions.

TRANSPORTATION EDUCATION AND TRAINING NEEDS

The purpose of this session was to examine the role that university programs play in helping transportation agencies meet the challenges they face in the coming decade. Each panelist was asked to prepare comments based on three questions that served as the underlying themes of this session:

1. How can university programs help transit agencies meet the challenges they will face in the coming years?
2. What experience have you had that illustrates this type of interaction?
3. What are some of the problems that will be faced by universities and transit agencies in developing joint-action programs?

Because the presentation of each panelist followed the outline suggested by these questions, this session summary will follow a similar format.

Role of Universities

Several panelists began their discussion of this topic by asking what the challenges are that face the transit industry in this decade and who has defined them. Although the challenges will surely include a declining funding base and a need to gain increasing public acceptance of transit service, several panelists from the transit industry suggested that the most serious challenge is the lack of skilled managers. According to one transit official, because of their age (middle to late 50s), transit managers will need replacement in great numbers, which will make the next five years critical for the industry. Key staff persons lost through death, early or normal retirement, or other reasons will accelerate the rate at which management personnel must be replaced. Some replacements will be new to the industry, straight from college. Others will come from the ranks. The first group will have to learn the transit-specific job-related skills needed to supplement their academic preparation, whereas the second group will have to acquire needed skills in management, administration, and finance. It appears that greater use of short, intensive continuing-education courses that contain transit-specific material and are taught (at least in part) by transit personnel who have such expertise would be the best way to transmit the needed skills to both groups.

It was pointed out by one university representative that the universities will also be facing challenges in the next 10 years, some of which are already demanding attention. Specifically, many university transportation programs are facing a large influx of foreign students, which creates administrative problems as well as serious concern about curriculum offerings. Other challenges include the difficulties of incorporating a management emphasis in technically oriented education programs and of encouraging more women to enter the transportation field.

The panelists suggested several ways in which universities could help transportation agencies in the future. Five areas of involvement were identified in which opportunities are available for important contributions by university transportation programs:

1. Policymaking: Through its research program and publications the university provides a forum for influencing public policy regarding public transportation. In most cases, the university is the only place at which basic research on transportation policy is being conducted. Also, the university serves as a natural meeting ground for the analysis and discussion of public policy issues.
2. Formal education and training: The university can develop new curricula (or courses), new degree programs, or both in response to perceived needs for personnel. The major purpose of a university transportation program is educating future transportation professionals, and the university should thus be sensitive to the needs of the industry. Closer interaction between transit officials and educators is needed.
3. Continuing education: The university can provide courses and programs scheduled or arranged to meet the needs and orientation of industry personnel. UMTA Section 10 grants for management development have made it possible for many industry personnel to attend such programs. These continuing-education programs should be designed to help all management levels of the industry.
4. Special training programs: Universities have unique resources for providing training programs in response to industry and university perceptions of need. Seminars and workshops can be used to provide special training needed for mid-level and upper-level management personnel, and university faculty can also participate in establishing training programs at all organizational levels.
5. Technical assistance: University programs through research or faculty consulting can provide services, resources, or both to address specific transportation problems. Student projects often serve as a good way to provide this assistance and also serve as an educational opportunity for the student.

As can be seen from this list, there are several areas in which universities could have an important impact on transportation agencies and their employees. As pointed out by one university panelist, however, the primary objective of graduate programs in transportation education is to prepare broadly educated and well-trained students to deal with the complex problems of transportation in future urban and rural areas. The student's educational experience should prepare him or her to become an effective decision maker without the need for a vast amount of experience upon which to base the decisions. It is in this area of education that the university's greatest impact will be felt.

Recent Experiences in Interaction Between the Industry and the University

Several examples of university programs that have undertaken activities in the areas listed above were given by the panelists. The most interesting one as

it related to interaction between a transit agency and a university was a program developed between SCRTD and local universities. Several local universities provide ongoing programs for SCRTD personnel; these include the following:

1. California State University at Los Angeles is teaching advanced computer programming for district personnel only.
2. Each of SCRTD's top-level and mid-level managers (approximately 100) has a profile of training needs; universities provide the classes to meet many of these needs by means of short courses and seminars.
3. Employees who participate in two tuition-reimbursement programs attend at least four different universities or university systems on 10 different campuses.
4. University faculty are often used as consultants to conduct in-house programs on such topics as conflict management and technical writing.

Perhaps most interesting, however, is an SCRTD program with the University of Southern California (USC) to provide a regional transit training center for the western United States. The purpose of this center was to find a way to train new and newly promoted employees economically, to share knowledge among transit properties, to ensure that all training is transit specific, to combine both the practical and the theoretical needs of transit properties, to provide continuous training in commonly needed subjects, and to provide one-time training in special subjects as needed. The role of USC in this center was to develop a curriculum, conduct some training activities, and evaluate these training efforts.

Five programs were developed for the first year's effort: training of operations supervisors, selection and promotion of personnel, organizational analysis, mid-level management training, and an executive institute. SCRTD officials involved the university in the program because it was best suited to incorporate new managerial and technical concepts into the curriculum and because professors were important contributors in deciding how the training should be conducted and evaluated.

The SCRTD-USC program is one example of how universities can become involved with local transit agencies. However, as stated by several panelists, there are often many problems that must be overcome to develop such cooperative programs.

Problems in Developing Joint-Action Programs

One of the most chronic problems in agency-university cooperative actions is the lack of communication between the academic community and the transit industry. One transit agency panelist complained that too many university offerings are irrelevant to the needs of the industry and the result of little effort on the part of universities to find out what these needs are. It was felt that colleges and universities could work toward becoming more responsive to the needs of the transit industry in several ways. They could survey the transit properties. They could and should continually revise and update their course offerings to reflect the quickly changing situation with regard to transportation. And they should ask more personnel from the transit industry to become guest lecturers. There are many such potential guest lecturers in both transit agencies and UMTA and the American Public Transit Association to fill such roles in transit-specific programs.

From the university perspective, there are several difficulties caused by recent enrollment trends and by the structure of disciplinary fields within the university organization. A major problem that faces engineering and science programs in general is a national trend toward a declining graduate enrollment. Specifically in the transportation area, the evolving impact on the graduate programs is that

1. Total enrollments in transportation programs have leveled off and are declining,
2. A greater percentage of students in transportation programs are from foreign countries, and
3. A greater percentage of students in transportation programs do not have technical backgrounds.

This enrollment problem is one that will greatly affect the industry in the middle and late 1980s. In addition, however, solution of many of the problems that face transportation agencies requires a multidisciplinary approach, and many university departments are unwilling to conduct such efforts. Many disciplines do not recognize the need for interaction, others cannot communicate with each other, and few understand each other's concerns. These are serious obstacles to an effective university contribution to the solution of the problems of the transit industry.

In summary, this panel session identified a set of opportunities for closer interaction between universities and the transit industry. In some cases, interesting and productive programs have already been established. However, the universities will be facing serious challenges in this decade, as will the transit industry; both groups need to recognize that one can help the other face these challenges. The most important task in the short term is to open a dialogue between the two groups that will, it is hoped, lead to effective joint-action programs.

STATE AND REGIONAL RESEARCH NEEDS--THE UNIVERSITY ROLE

The purpose of this session was to conduct a dialogue between those in federal, state, and local agencies and those in universities concerning the conduct of transportation research at universities. The panelists were asked a number of questions about both the conduct and the management of research. These questions included the following:

1. Can university research programs respond to transportation needs as defined by departments of transportation (DOTs) at every level (federal, local, and state)?
2. How can universities organize to respond to such research needs?
3. [illegible] universities respond to local needs?
4. [illegible] state and local governments take advantage of university capabilities?

Because many of these questions are interrelated, the panelists did not respond to each one but instead addressed the more-general aspects of transportation research at universities in the context of these questions. The more-salient points are summarized below.

Long-Term Versus Short-Term Research

The distinction between long-term and short-term research is one that must be made. Long-term research is critically needed to gain a better understanding of the development of transportation needs at future horizons of more than five years. However, much of the research being undertaken today by various DOTs is of short term and very strongly de-

cision oriented. Efforts at meeting state and local needs are directed at finding solutions to daily crises; long-term needs are rarely considered. The research requested is very applied and may have no great impact on the evolution of long-term problems. State and local agencies often do not have funds to establish any but the most basic research programs--those that provide quick answers to immediate problems. Research per se is of low priority at state and local levels. The emphasis on long-range problems does not take advantage of some of the unique aspects of the organization of universities. These include continuity of staff and the ability to put together unique research teams to examine complex problems over a period of time.

Need for Diversity

In addition to the time scale of research, there is need for greater diversity in the transportation problems on which universities work. This diversity must cut across the various modal issues, transmodal issues, and overall transportation policy. There should be more-widespread input to the origin of problems that universities address. In particular, the Research and Special Programs Administration (RSPA) program of the Office of University Research of DOT was perceived as being too narrow, the problems too focused. Although it is the intent of DOT to have these problems addressed in a somewhat more-general way, it is the perceptions of university researchers and their responses to these perceptions that create the general impression of narrowness of the program. It was noted that there is no longer a plan for university-originated research topics within the two categorical research programs (UMTA and RSPA). This was believed to limit the definition of problems that DOT would address and to limit the diversity of responses possible from universities.

Lack of Clarity in Federal Needs

Coupled with the above decision, it was noted by both DOT personnel and university representatives that there is a lack of clarity in federal research needs. There is little continuity, for example, from one year to the next in the RSPA solicitation. This reflects changes of priorities within DOT and makes it difficult for universities to put in place research teams capable of dealing with complex problems over long periods of time.

Continuity

To sustain a research effort, there must be assurances of continuity within a university. Thus, DOT programs should be organized to allow some continuity of funding and support on more than a yearly basis. One method of organization for such support could be transportation centers or programs. UMTA now has program support at universities, but the level of funding from UMTA programs is low, which limits the extent and scope of such programs. Through such programs, universities can organize themselves to allow for spells of low funding for research. These programs could also have specific themes at various institutions, if one assumes that there is diversity of effort and long-term approaches to research. Programmatic research would also put more pressure on universities to conduct multidisciplinary work and to remove more traditional department barriers.

Uniqueness of Universities

Universities are unique. They are not like consulting firms or federal agencies. The main objective of universities is the advancement of the state of knowledge. Universities also have a responsibility to train and educate persons in special areas by using both the philosophical and the programmatic foundations of knowledge in these areas. In this context, research has a special role within universities.

The academic staff has a degree of independence and unique and diverse views that are necessary in both the conduct and the questioning of research. Universities can often do work for agencies that may be too controversial for consultants or work on projects that need an out-of-house viewpoint. Because of the breadth of skills present at a university and the high level of knowledge represented in each of these skills, unusual or multidisciplinary teams can be used on these research problems. The uniqueness of universities is also represented by students. Federal, state, and local agencies want to hire the best talent available. In addition to the technical, in-class training, students benefit from working on problems similar to those they will address as practicing professionals. Further, the connections the students make between their class theory and the pragmatism of problem solving will increase their value to future employers. This latter concept cannot be emphasized enough. Research programs must be supported at universities to ensure the integration of the formal academic training of undergraduate and graduate students with the problem-solving skills needed by the transportation professional.

Training of Minorities

There exist a number of institutions for minorities that have institutional handicaps that make addressing transportation research problems a difficult task. There are federal commitments, some programs for schools for minorities, and some dollars set aside, but these are not enough to overcome the difficulties faced by these universities. Reduced federal research budgets will make it difficult to extend research at all universities and in particular at institutions for minorities.

In summary, a number of major issues were raised at this session. The most significant concerned the lack of a long-range research focus by DOT and the emphasis on solutions to current crisis problems (most often applied rather than innovative solutions) at the state and local levels. Universities, through their composition and organization, have unique contributions to make, and it was concluded that the dialogue must continue to ensure a better integration of university capabilities into the DOT research agenda.

The Transportation Research Board is an agency of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's purpose is to stimulate research concerning the nature and performance of transportation systems, to disseminate information that the research produces, and to encourage the application of appropriate research findings. The Board's program is carried out by more than 250 committees, task forces, and panels composed of more than 3100 administrators, engineers, social scientists, attorneys, educators, and others concerned with transportation; they serve without compensation. The program is supported by state transportation and highway departments, the modal administrations of the U.S. Department of Transportation, the Association of American Railroads, and other organizations and individuals interested in the development of transportation.

The Transportation Research Board operates within the Commission on Sociotechnical Systems of the National Research Council. The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the federal government. The Council operates in accordance with general policies determined by the Academy under the authority of its Congressional charter, which establishes the Academy as a private, nonprofit, self-governing membership corporation. The Council has been the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine.

The National Academy of Sciences was established in 1863 by Act of Congress as a private, nonprofit, self-governing membership corporation for the furtherance of science and technology, required to advise the federal government upon request within its fields of competence. Under its corporate charter, the Academy established the National Research Council in 1916, the National Academy of Engineering in 1964, and the Institute of Medicine in 1970.